



DIRECT – Safer, Simpler and Sooner

DIRECT • Space Transportation System Derivative

JUPITER¹³⁰

Presentation before the
Review of U.S. Human Space Flight Plans
Committee
Washington DC, June 17th 2009

www.directlauncher.com



DIRECT Implements the Policy within the Available Budget

2005 NASA Authorization Act

Develop a heavy-lift launch vehicle using the personnel and infrastructure of the Shuttle

Minimize the Gap between the Shuttle retirement and its replacement

Learn how to mitigate the effects of space on the humans

Returning Americans to the Moon no later than 2020

Build the base for human surface missions to Mars on a timetable that is technically and fiscally possible





What is Jupiter?

DIRECT_{v3}
safer, simpler, sooner



NASA Copyright 2008



Jupiter 'is' the Historic NASA STS Derived Approach



**Morton-Thiokol
1978**



**National Launch System
1992**



**Jupiter-DIRECT
2006**



Jupiter Builds upon Existing STS Hardware

Ares-I

New 5-Seg. SRB
New J-2X Engine
New Configuration
New Infrastructure
New Upper Stage
Limited Orion
Safety Requirements
Reduced

\$14.4 Billion for
system that is less
capable than an
EELV



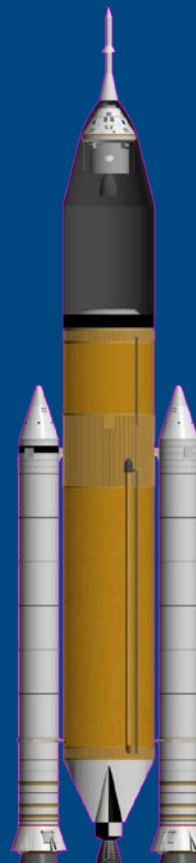
STS



Jupiter-130

Existing 4-Seg. SRB
Existing SSME Engines
Existing Configuration
Existing Infrastructure
No Upper Stage
Lunar Class Orion
Safety Requirements
Achieved

\$8.3 Billion for
system that is much
more capable than
an EELV



\$14.4 Billion*

← Total Development Cost →

\$8.3 Billion

March 2017 ←

← Operational Date →

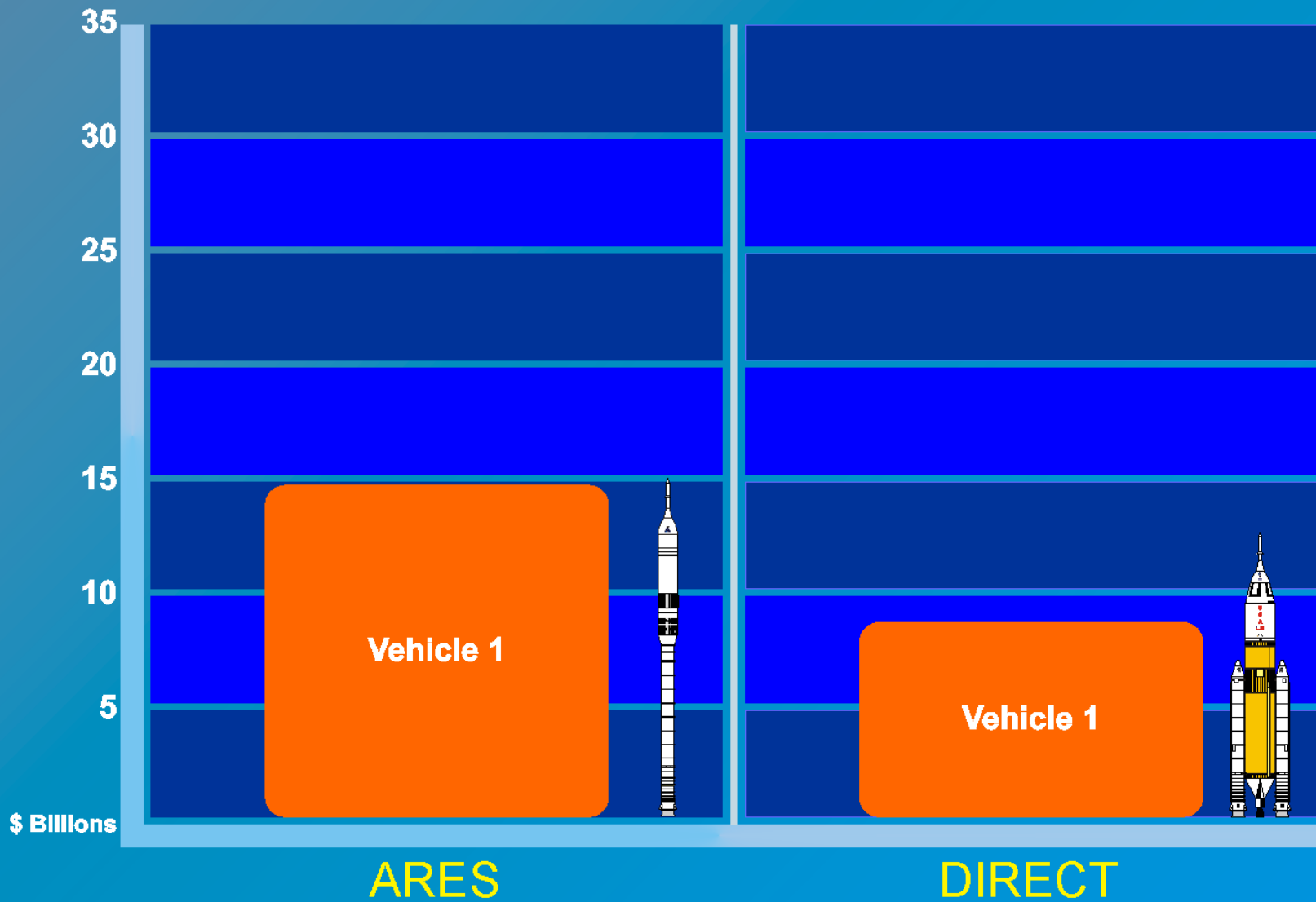
→ September 2012

DIRECT Closes the Gap within the Current Budget

**Orion is the Pacing
Item not the Launch
System**

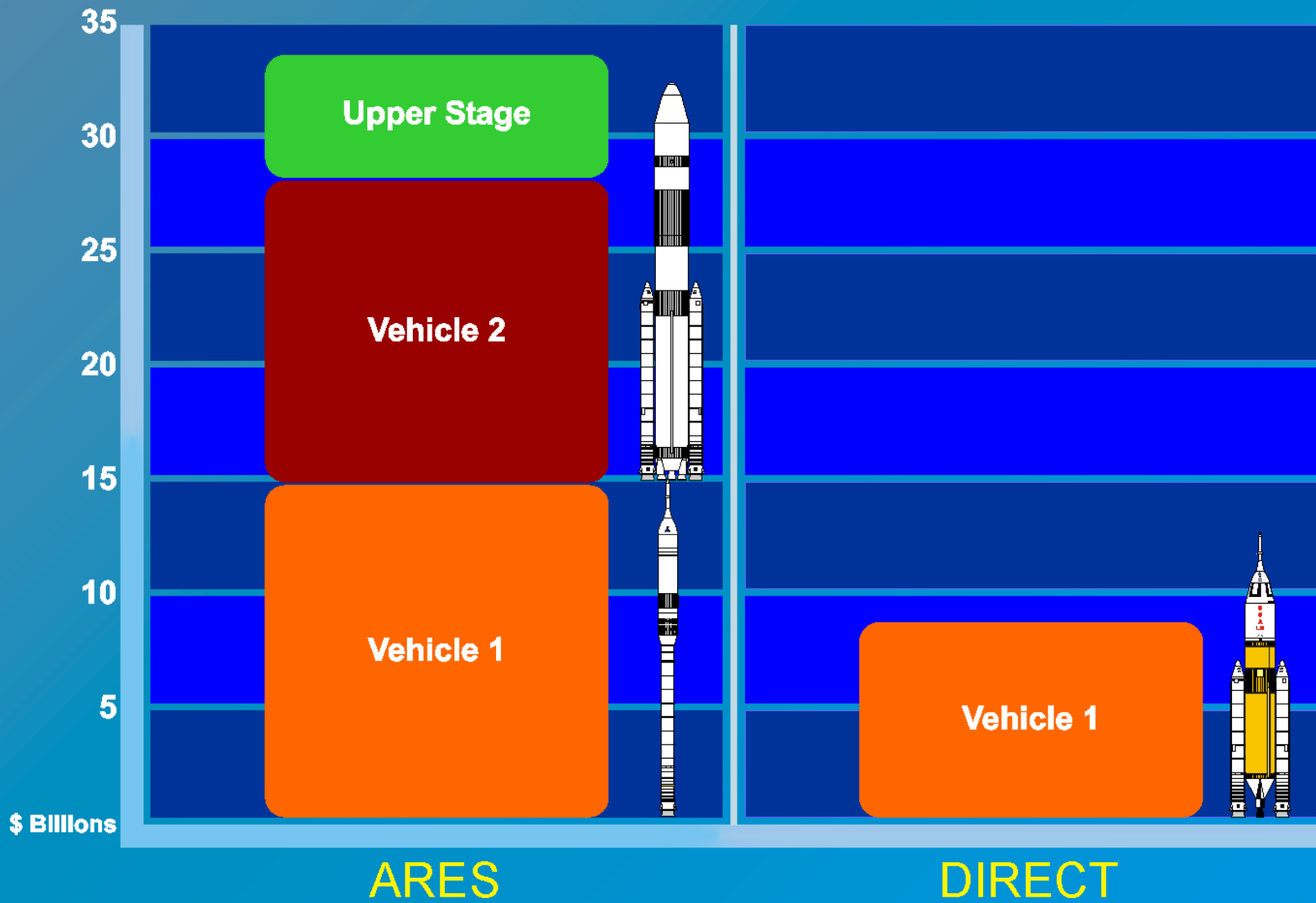


DIRECT Creates New Capabilities at a Lower Cost



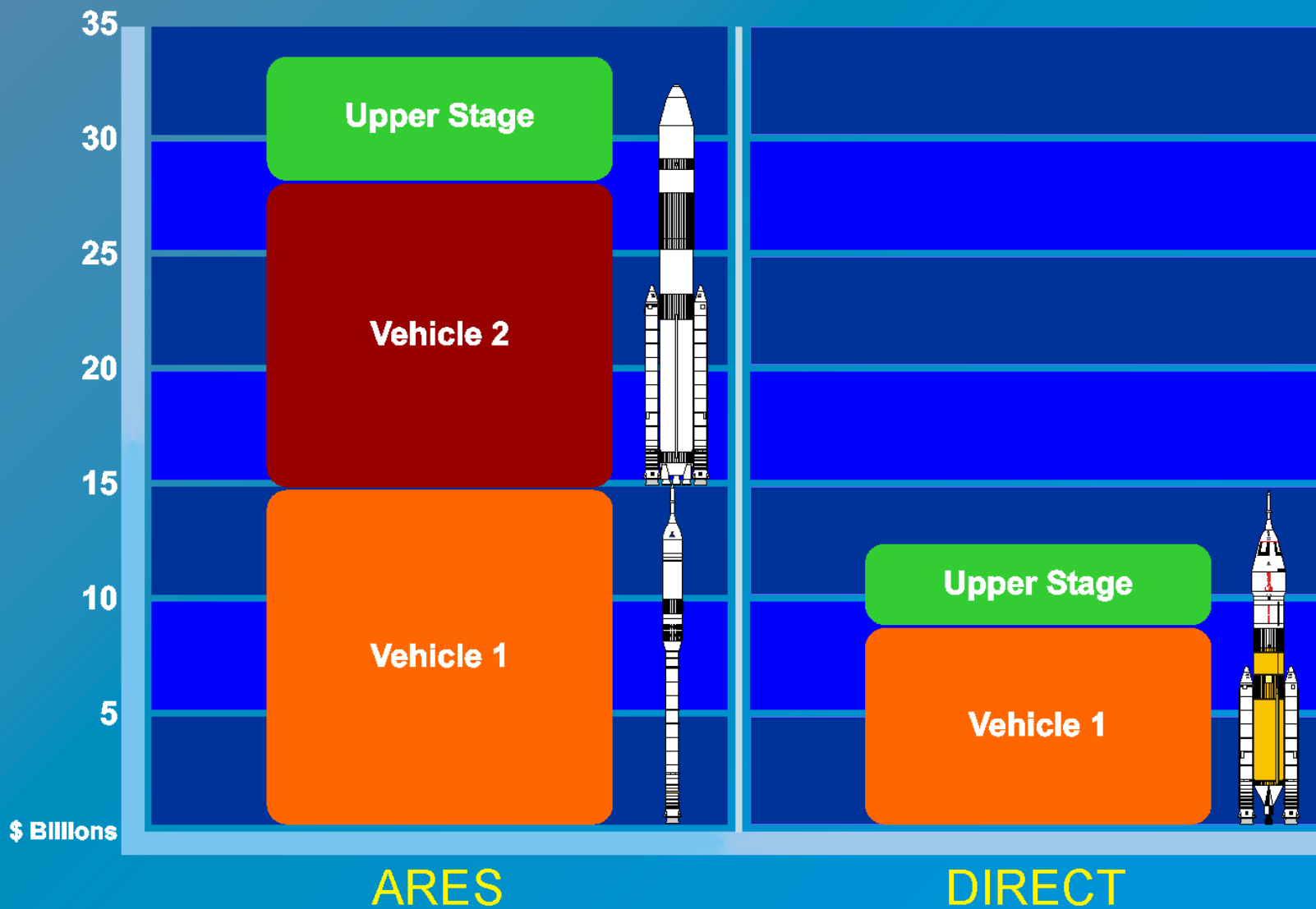


Two Different Launch Systems "Busts the Budget"





DIRECT's One Launch System Comfortably Fits the Budget





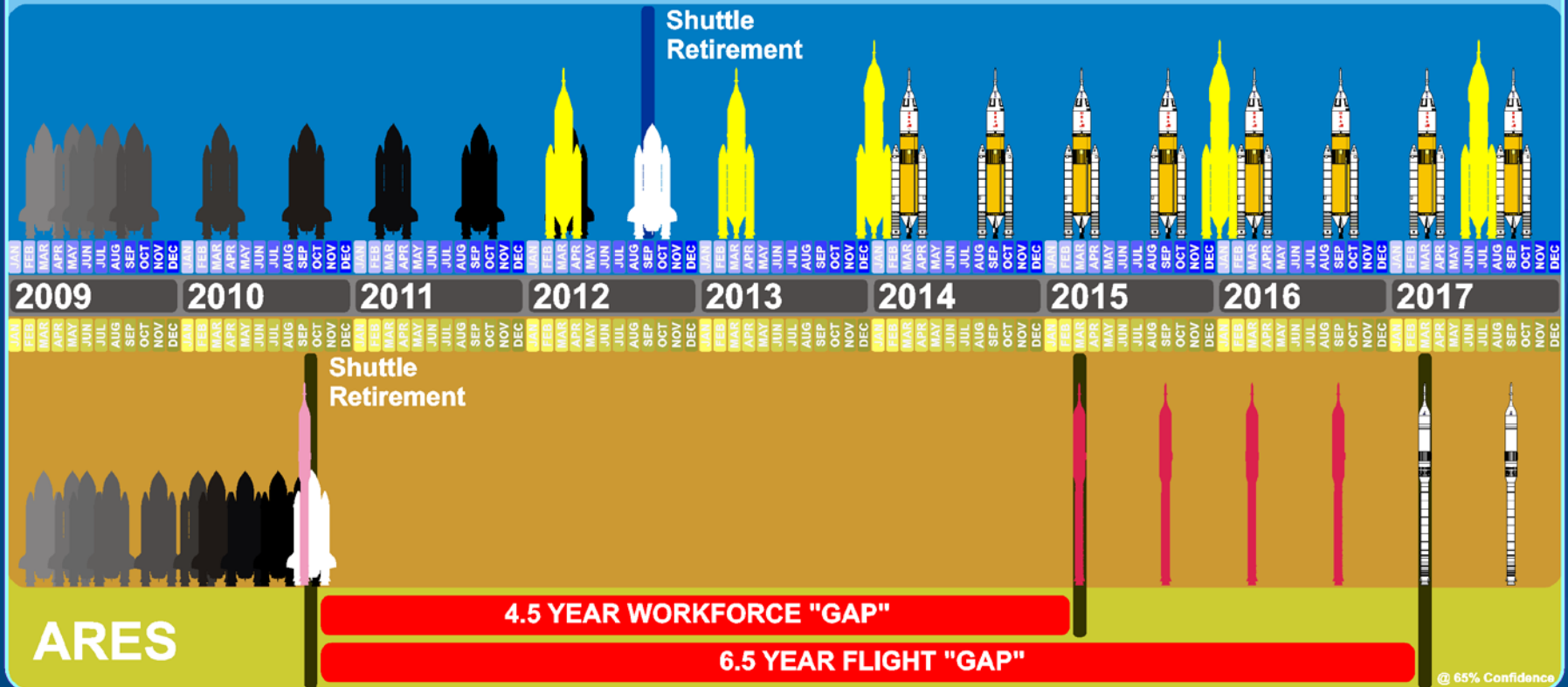
DIRECT Eliminates the Workforce & Flight "GAP" at KSC

DIRECT

NO WORKFORCE "GAP"

NO FLIGHT "GAP"

@ 95% Confidence



- Stretching out the shuttle flights will provide a safer transition
- The STS Workforce is a asset for the Jupiter not a liability like with Ares
- 12 IOC Jupiter vs. 1 Ares flight thru March 2017
- The Jupiter-130 can fly 50mT of mission payload with every crew

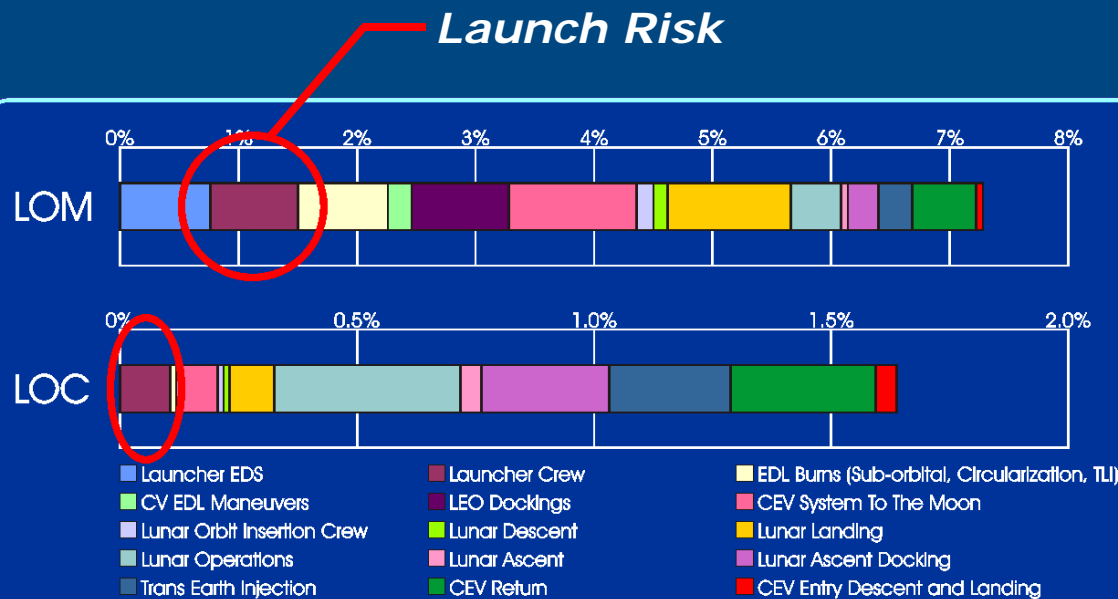


DIRECT Improves Mission Safety, Not Just Launch Safety

The Majority of Risk is Directly Related to the Mission not the Launch

The Elimination of key Safety Systems and Redundancy due to Ares-1 Limited Capability has Significantly Lowered Overall Mission Safety

Jupiter Restores Orion's Safety, Capability while Speeding up Development and Lowering Cost thru Reusability





Jupiter Opens New Classes of Space Exploration Missions

JWST Service & Upgrade



Discovering Other Earths in the Galaxy



Find New Life in the Solar System

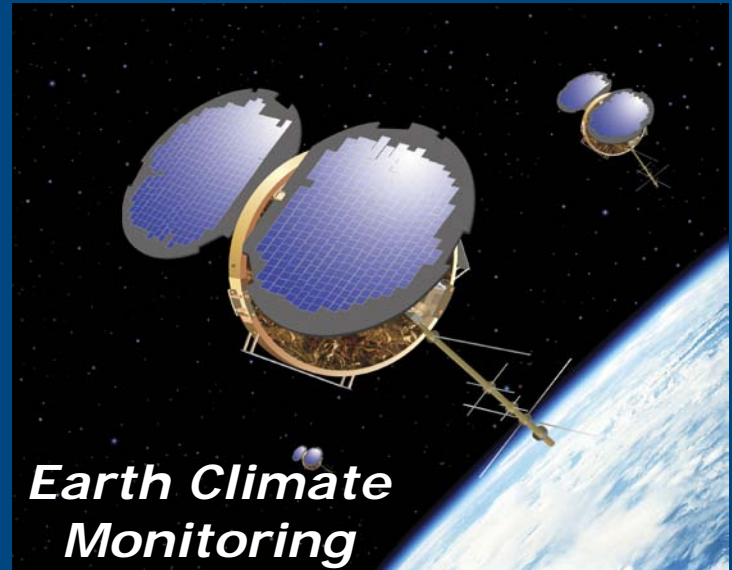


*Mars Sample Return
Advancing Mars EDL*





Jupiter Opens New Classes of Earth Focused Missions



*Earth Climate
Monitoring*



*Space Solar
Power*

**TOP
SECRET**

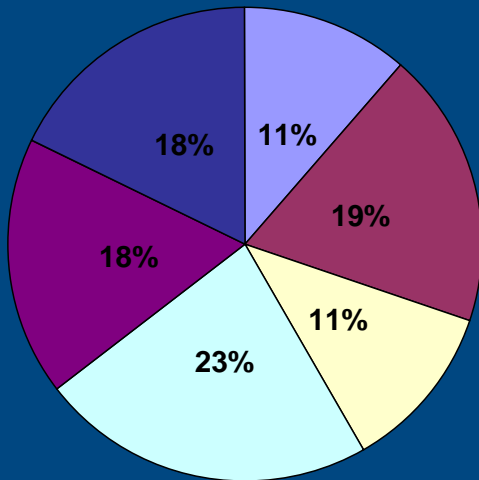
Defense



Jupiter will Lower the Cost to Orbit Significantly over STS

Current STS

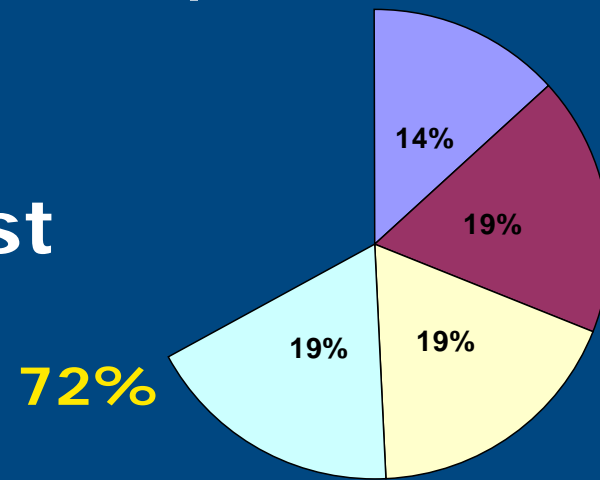
- External Tank
- SRB/SRM
- Engines
- Launch Ops
- Orbiter
- Mission Ops



\$2.6 Billion/yr*

Jupiter-130 CaLV

- Core Stage
- SRB/SRM
- Engines
- Launch Ops



\$1.9 Billion/yr*

Cost

72%

81mT/yr

Payload

389mT/yr

480%

\$32,385/kg

Cost Effectiveness

\$4,815/kg

6.7 Fold Improvement

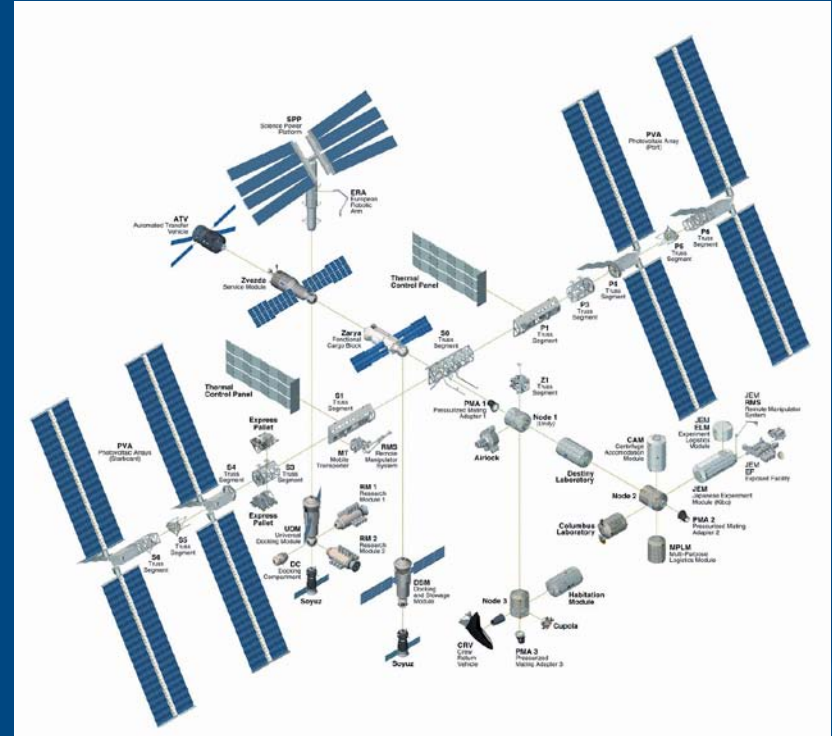


Jupiter will Also Lower the Cost of Spacecraft



Ground Integrated
One Launch
< \$1 Billion

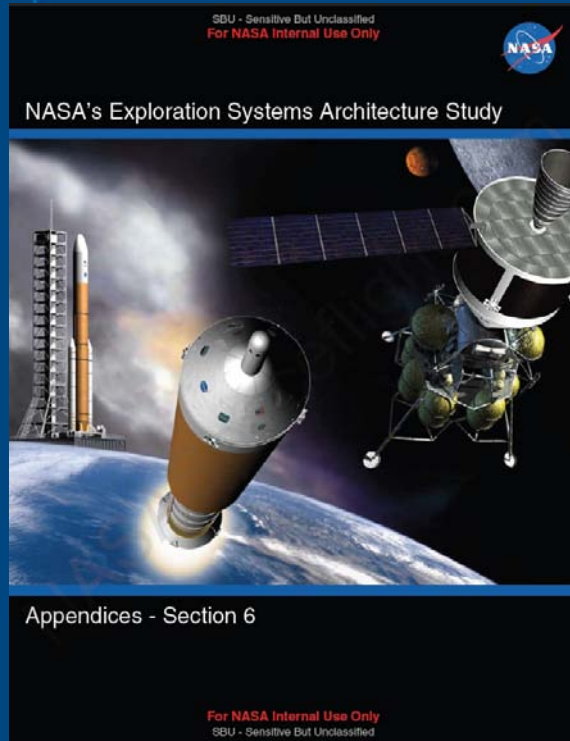
*"I hope we're smart enough that we never again try to place such a large system in orbit by doing it in twenty-ton chunks."**



Space Integrated
>60 launches
>\$100 Billion



The ESAS Appendix Confirms our Lunar Performance



"The claims for the direct launcher we can't justify based on laws of physics."

-NASA Associate Administrator Dr. Gilbrech to House Committee of Science and Technology, 3rd April, 2008

**ESAS Appendix 6:
LV-25 + S1A**

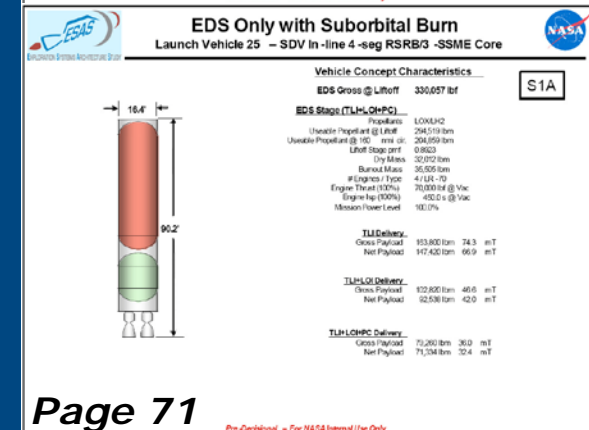
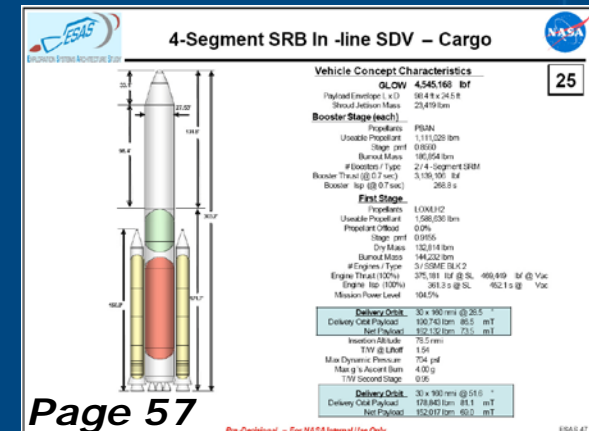
**Identical to the :
Jupiter-234 (SSME/RL-60)**

ESAS TLI Performance 74.3mT

CxP Requirement: 71.1mT

A requirement the Ares-1 and Ares-5 still can't meet.

NASA own leaked study proves that DIRECT approach has more than enough performance.





What About the Performance Needed for Mars?





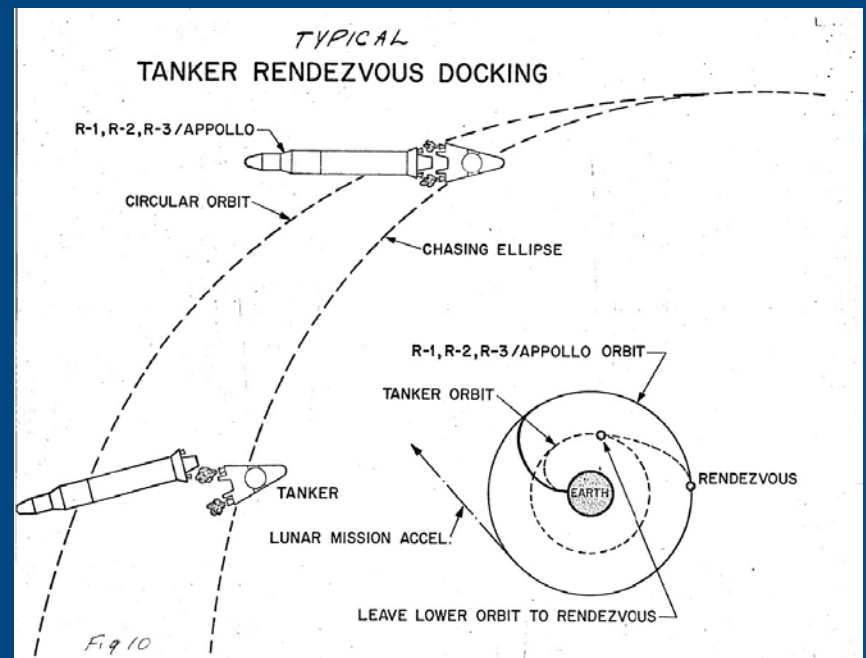
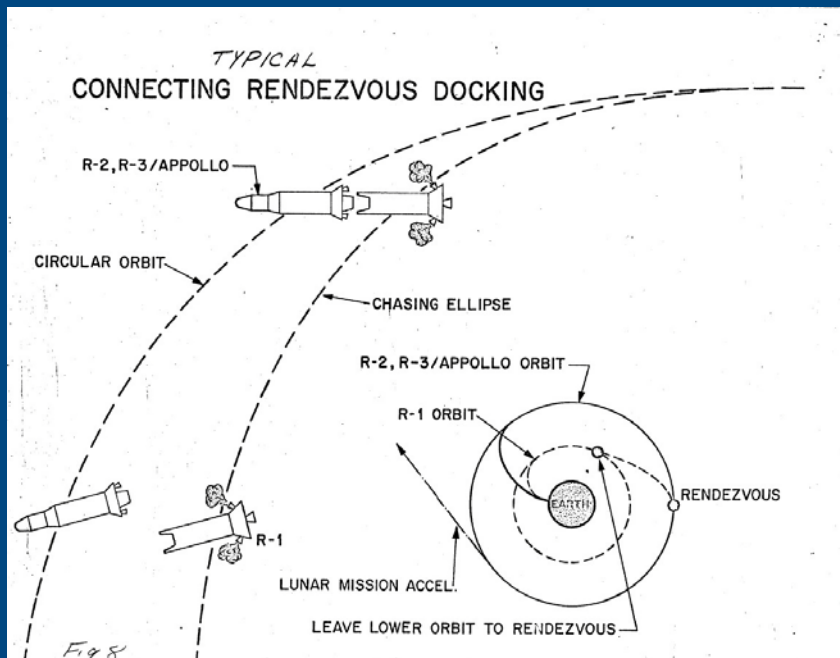
Wernher Von Braun Figured out Performance 46 Years Ago



"We found the Tanking Mode substantially superior to the Connecting Mode. The performance margin could be enlarged almost indefinitely by the use of additional tankers."

-Dr. Wernher Von Braun June 7, 1962

Most of the Mass Needed for a Mars Mission is Propellant





Propellant Depots are the Bridge to Long Range Exploration

Flexible and Extensible Mission Designs

~ 70% of the Mission Mass is Open for Commercial & International Supply

Builds the Infrastructure needed for Leveraging Lunar Resources

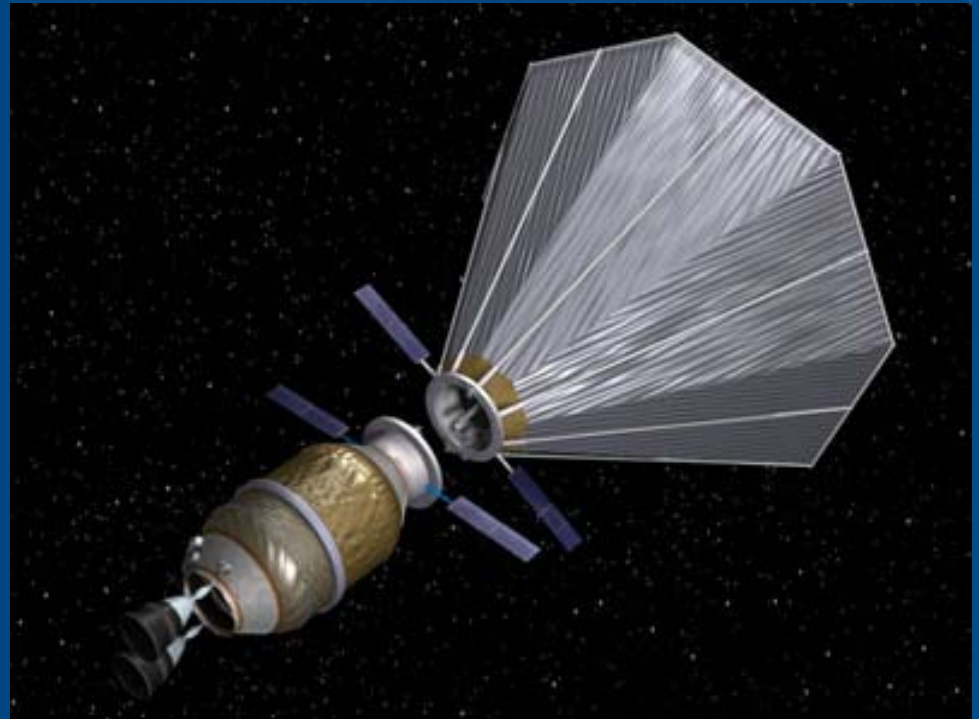
Enables Reuse of Expensive Spacecraft

Amplifies the Capabilities of all Missions by Partner Nations

Negates the Need for Super Heavy Lift like the Ares-5

The DIRECT plan meets the advocates of an exclusive EELV/COTS approach more than half way

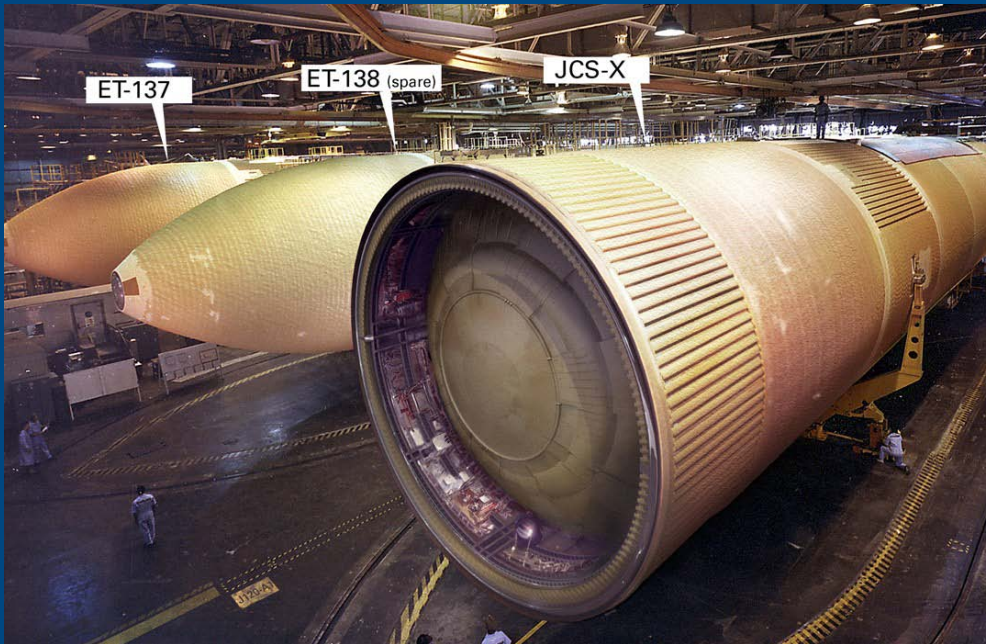
With more than enough demand to max out their existing facilities





Even now DIRECT is still our Best Option to:

- 1) Minimize the gap in US based access to ISS
- 2) Increase crew safety and mission success
- 3) Leverage the existing infrastructure & workforce
- 4) Build on the work already done
- 5) Fit the near and long term budget
- 6) Support new manned & unmanned missions
- 7) Attract international participation
- 8) Spur innovation and commercial competition



DIRECT efficiently addresses all the issues before the Commission within the limited time and budget that we have



Appendix



Why DIRECT is Important

America is about to experience the longest operational "GAP" since the Space Age began

We must prevent a repeat of what happened the last time we shut down an operational system without a replacement

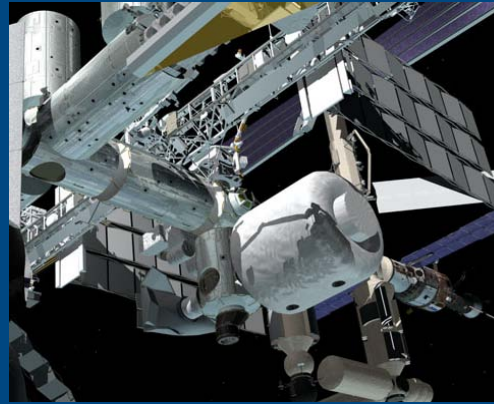
KSC will suffer the most if we repeat the mistakes of the past and continue to dismantle America's Second Heavy Lift System and Workforce

Fortunately thirty years ago NASA engineers designed a Shuttle Derived Heavy Lift Vehicle that will solve today's problems within budget





Jupiter is a More Capable & Safer Shuttle Replacement



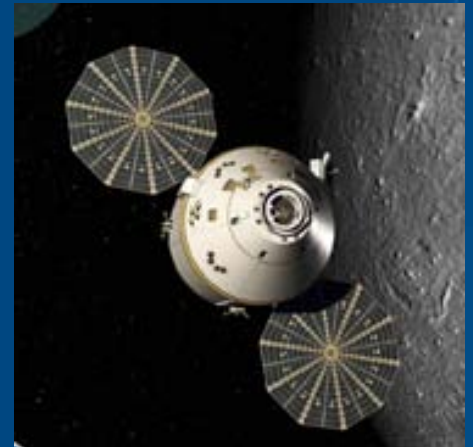
***ISS Service
& Upgrade***



***Hubble Service
& Upgrade***



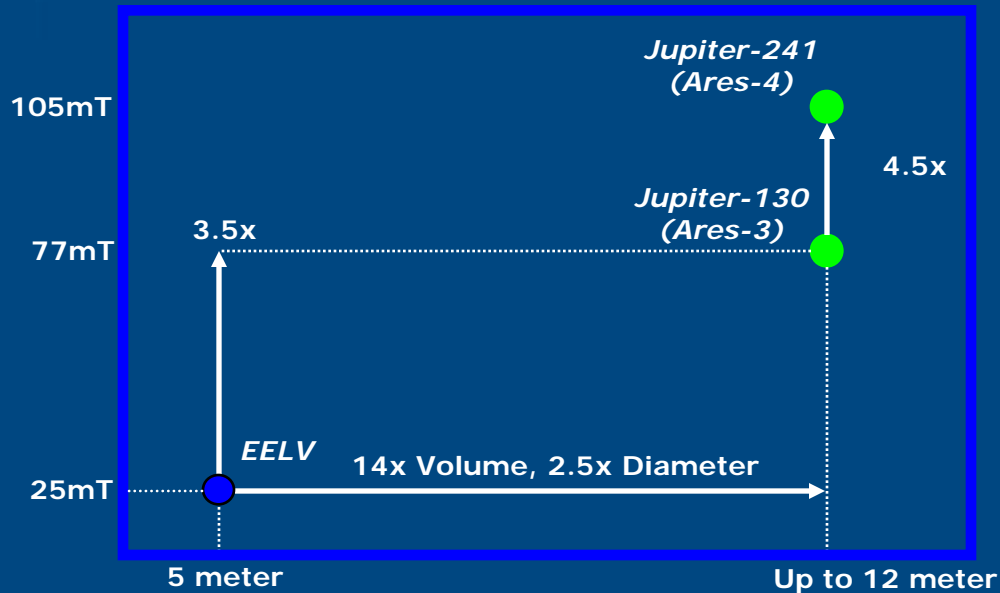
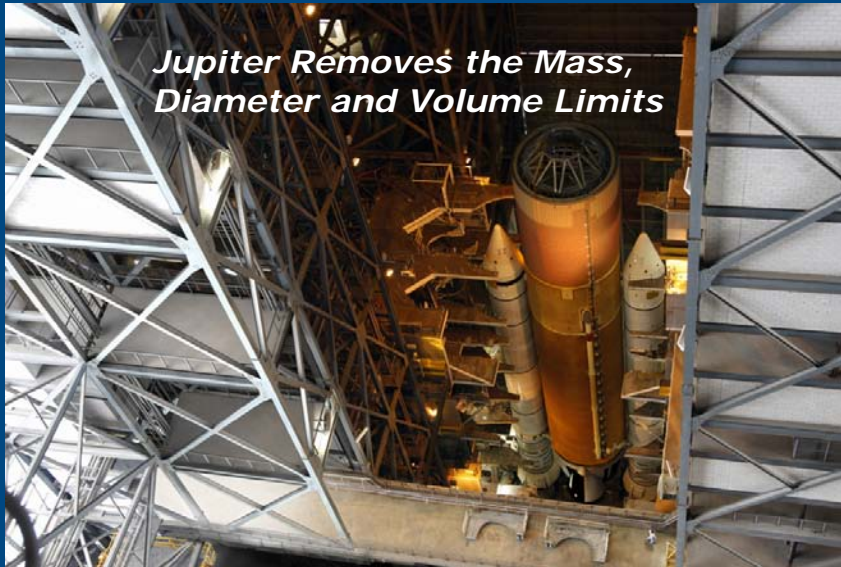
***Safer & Reusable
Orion***



***Lunar Capable
Orion***



Jupiter Removes the Limits of Current Launch Systems





DIRECT Provides a Smooth Transition from the Ares

Current Contractors

ATK
Launch Abort System

Lockheed Martin
Orion

Boeing
Ares-1 Upper Stage

Pratt & Whitney
Rocketdyne
Upper Stage Engine
(J-2X)

Boeing
Instrument Unit

ATK
Solid Rocket
Booster

Possible DIRECT Contractors

Altair?

Boeing
Jupiter Upper Stage

Pratt & Whitney
Rocketdyne
Upper Stage Engine
(J-2X/RL-10/RL-60)

Common Core Booster

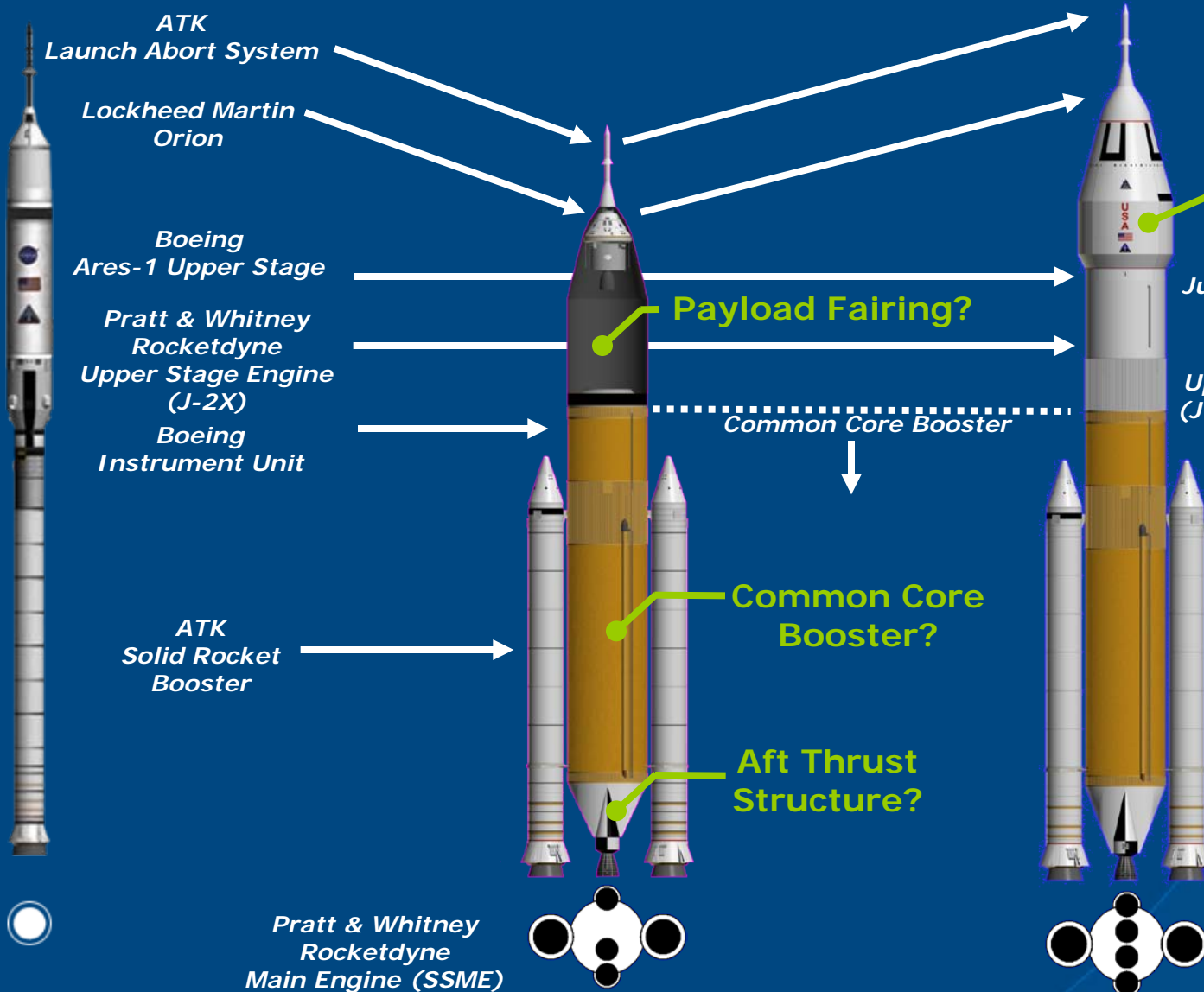
Common Core
Booster?

Aft Thrust
Structure?

Pratt & Whitney
Rocketdyne
Main Engine (SSME)

Jupiter-130

Jupiter-24x





DIRECT 's Proven Heritage Improves Safety, Cost and Time

Ares-I

Unproven 5-Seg. SRB

Unproven J-2X Engine

**Sub-Orbital Staging
Event**

**Unproven Thrust
Oscillation Mitigation**

Unproven SRB Staging

**Unproven Dynamic
Environment**



STS



Jupiter-130

**Proven 4-Seg. SRB
demonstrated 1 in 250
reliability**

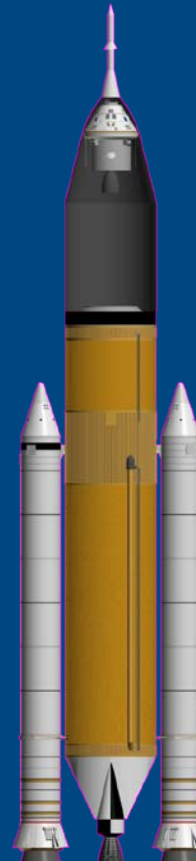
**Proven SSME Engines
demonstrated 1 in 362
reliability**

All Engines are Ground Lit

**Proven Thrust Oscillation
Mitigation**

Proven SRB Staging

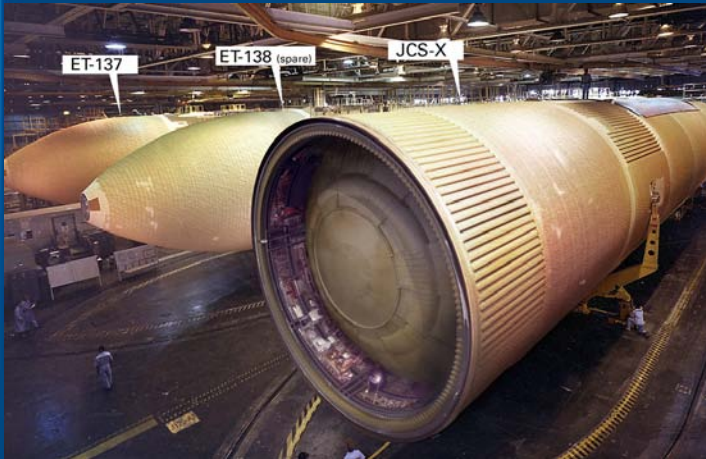
**Proven Dynamic
Environment**





DIRECT Closes the Flight, Workforce and Performance Gap

***Tooling is in place to begin construction of the Jupiter Core right now
Jupiter-130 by using existing SSME requires no engine developments***

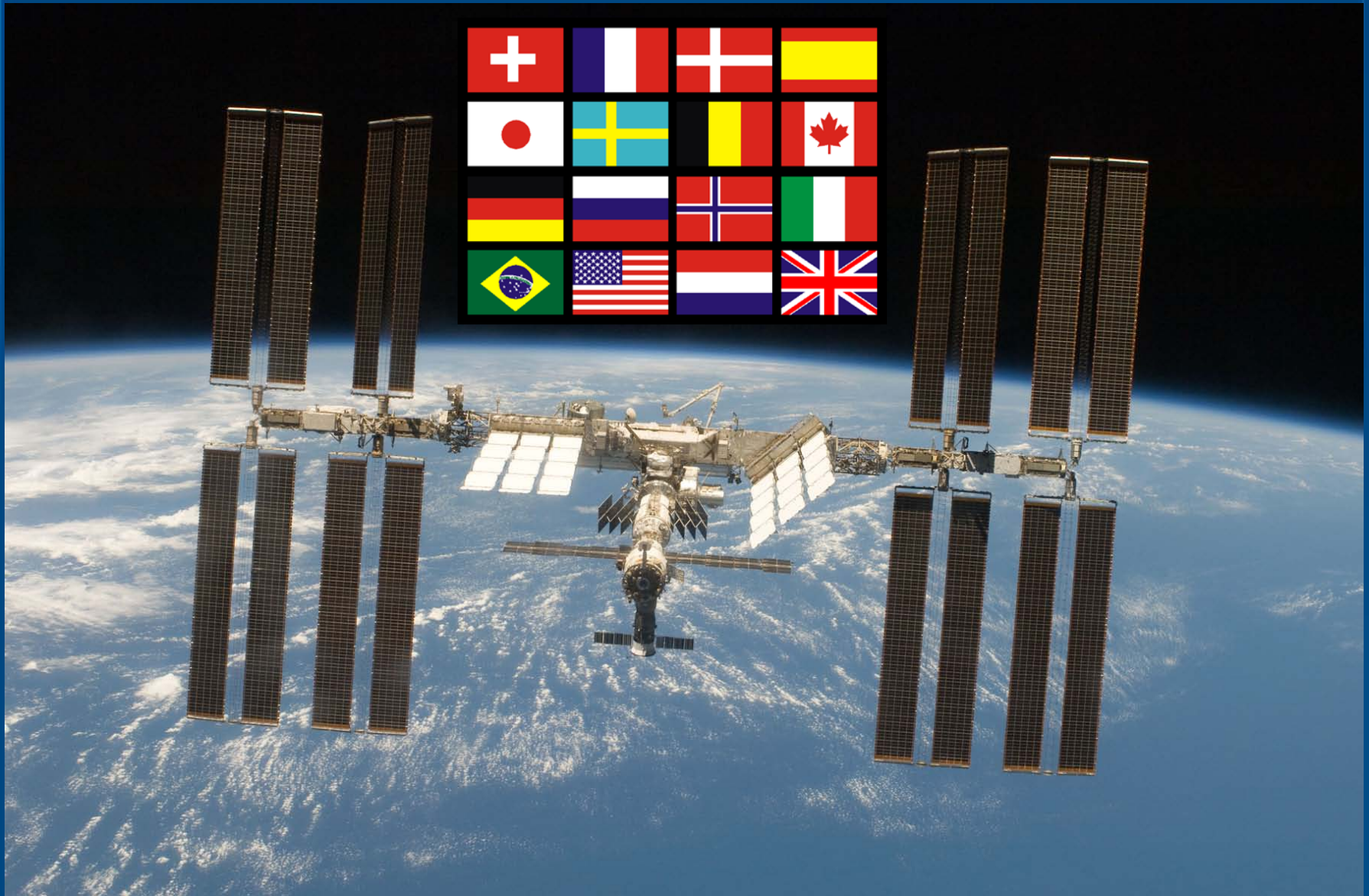


***Two-year Shuttle Extension to 2012 results in a
seamless transition between Shuttle and the
Jupiter/Orion Systems***

***The Shuttle workforce isn't an additional
expense when you actually need their skills***

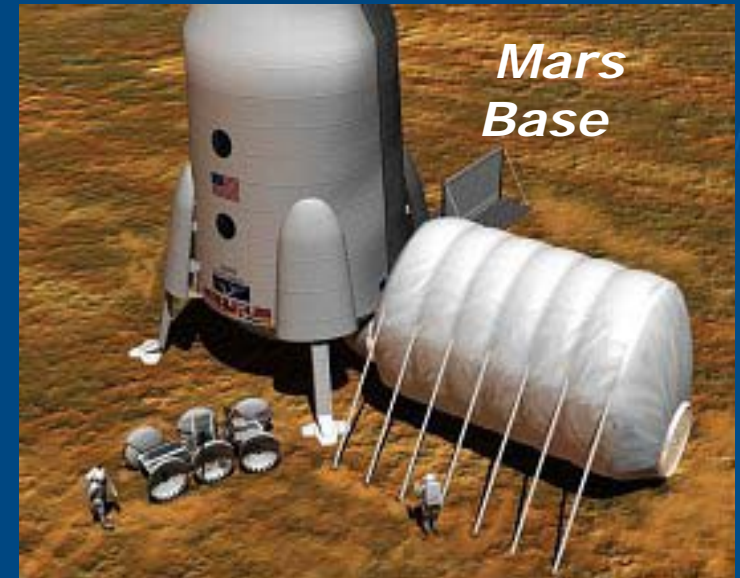
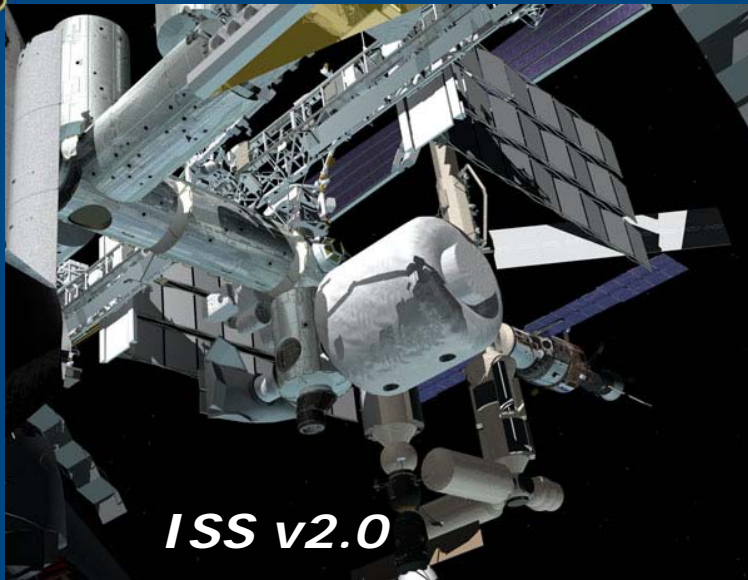


DIRECT Transforms the ISS into a Bridge to the VSE





The ISS has a New Life as a Platform for Testing Habitats

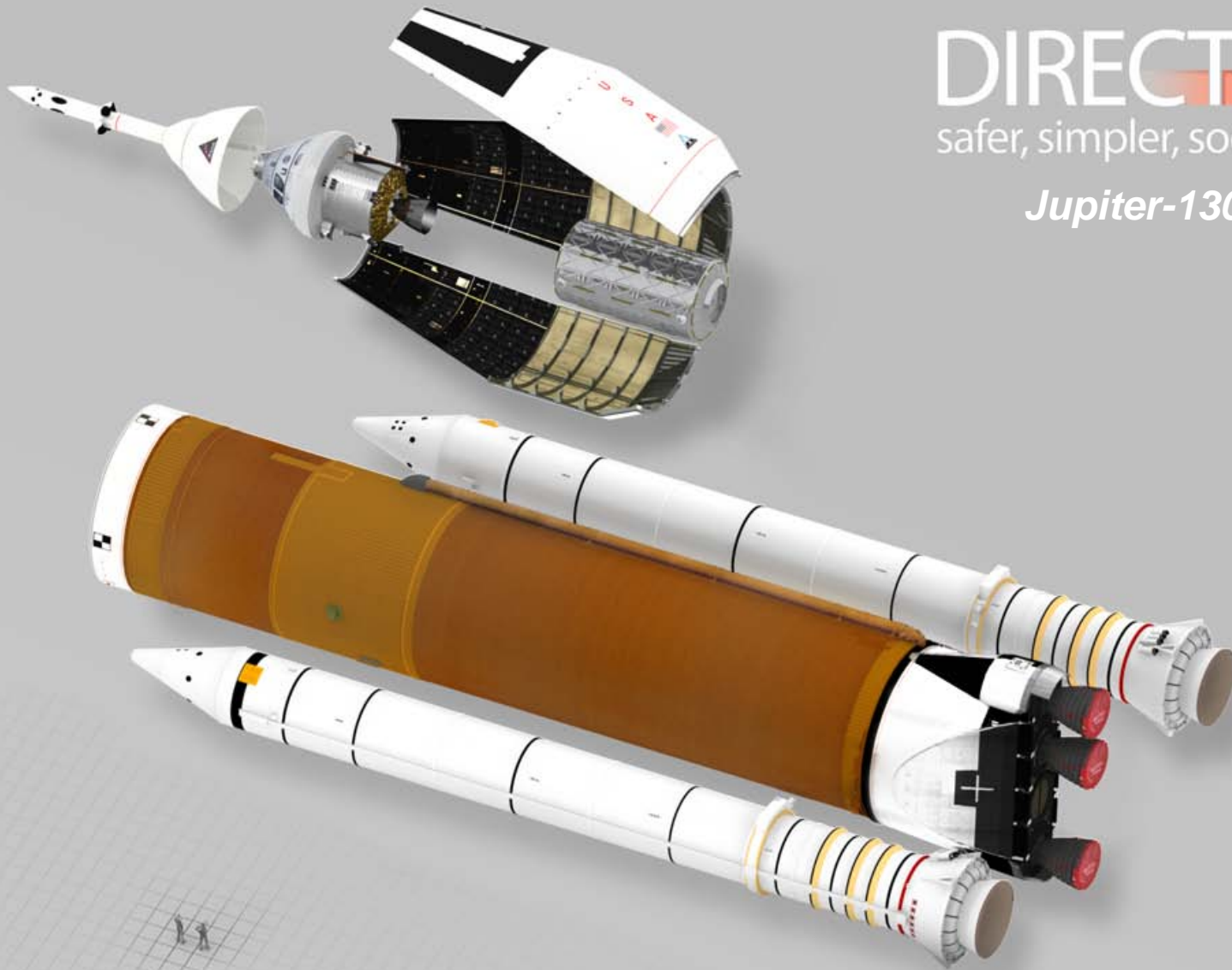




The Jupiter-130 Protects All Our Options Going Forward

DIRECT^{v3}
safer, simpler, sooner

Jupiter-130

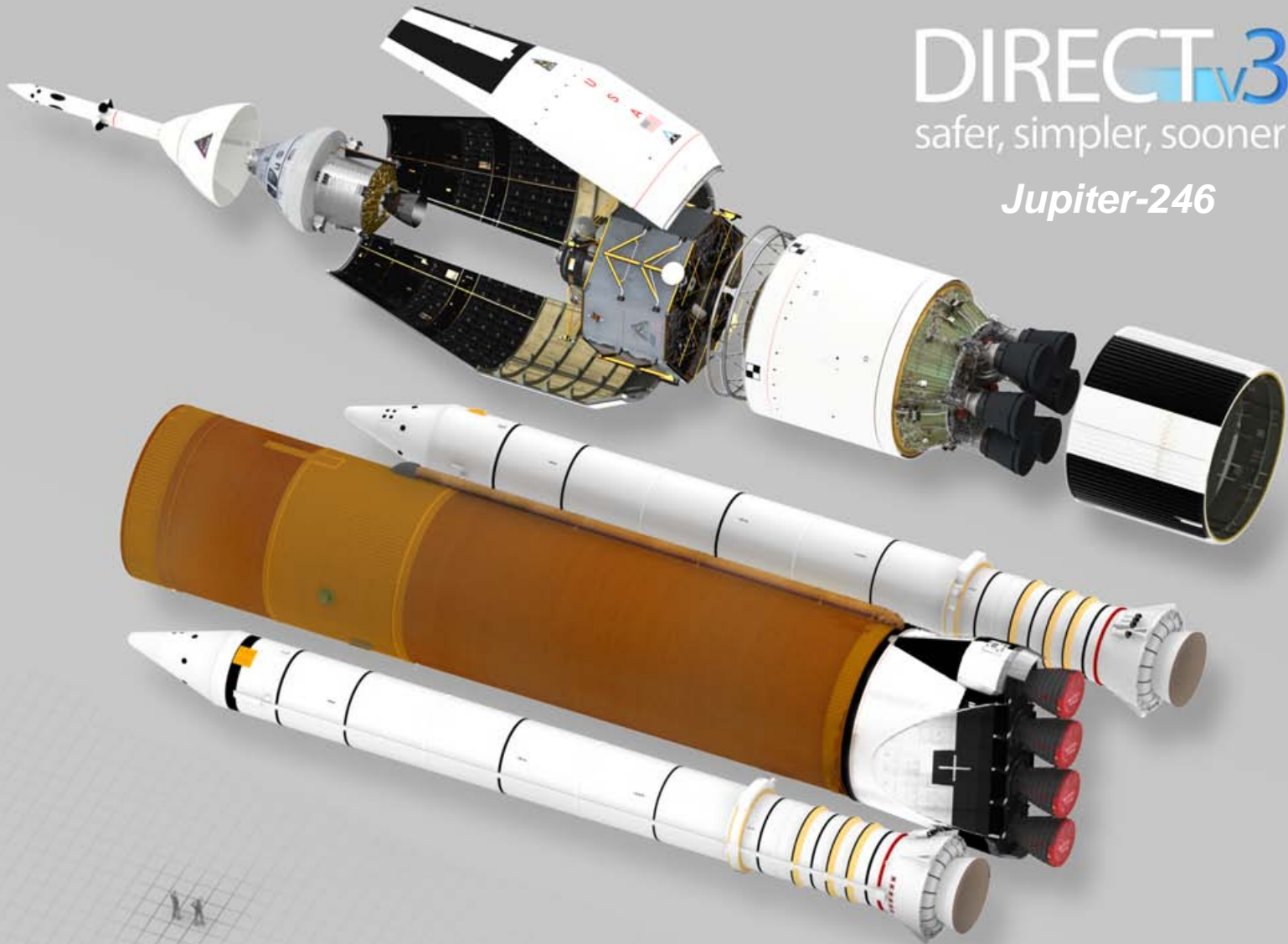




One Option Protected is Breakthrough Missions Beyond Earth

DIRECT_{v3}
safer, simpler, sooner

Jupiter-246

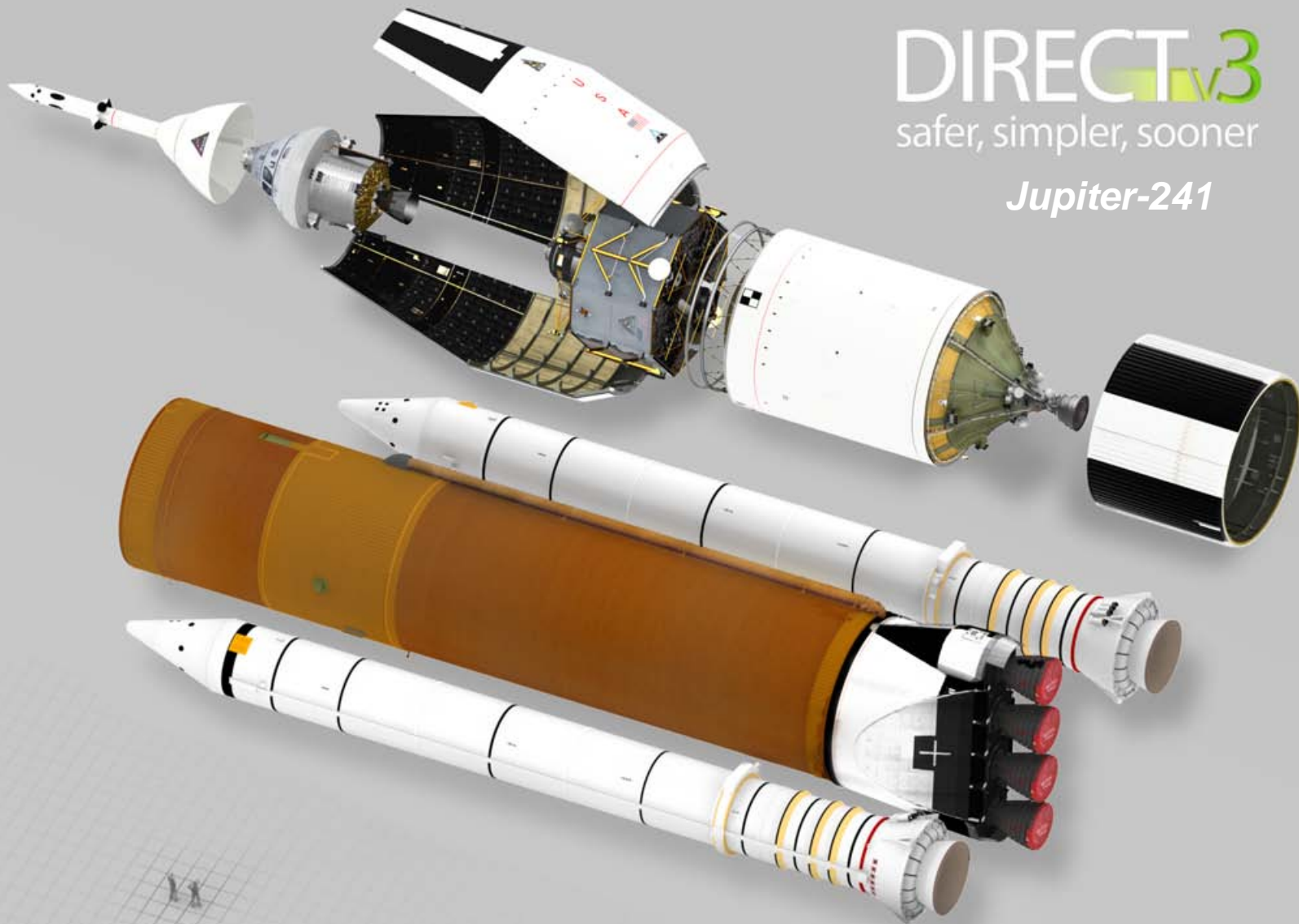




Jupiter-241 (SSME/J-2X)

DIRECT_{v3}
safer, simpler, sooner

Jupiter-241





NASA Admits the Benefits of One Launch System*

- ✓ *"The most obvious split involves launching two identical vehicles"*
- ✓ *"Costs are lower because of only one launch vehicle development"*
- ✓ *"Recurring costs are amortized over a larger number of flights"*
- ✓ *"Knowledge of system reliability is enhanced by ... flight experience"*

We agree 100% with the agency that one Launch System is Superior.

✗ *"However... [this] is vastly over designed for ISS logistics."*

This is Constellation's Single Point of Contention with DIRECT

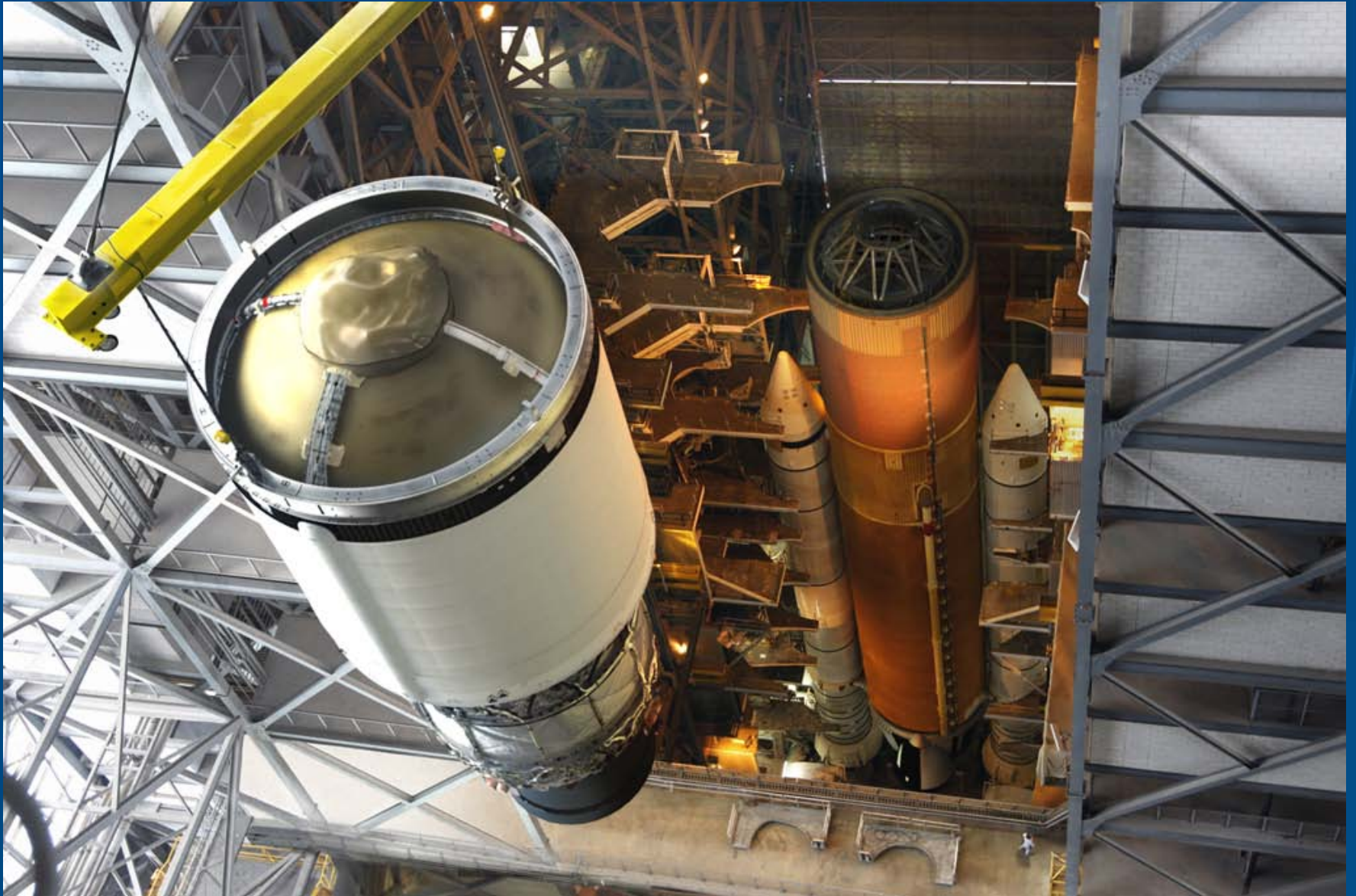
Without an upper stage the Jupiter is a close match for the ISS Crew + Logistics capabilities of Shuttle, only much safer and less expensive

Regardless, commercial launch services should provide long term crew access and routine supply to ISS

The VSE and Jupiter's primary focus is for beyond Earth missions

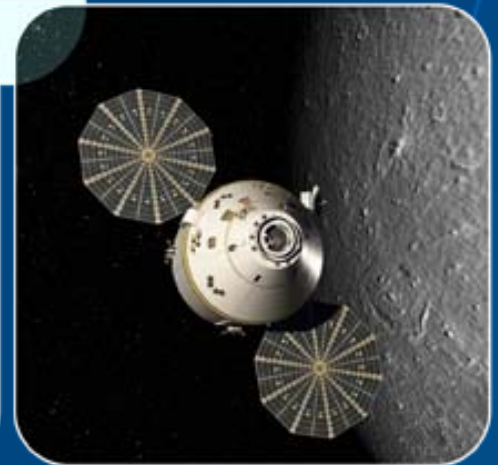
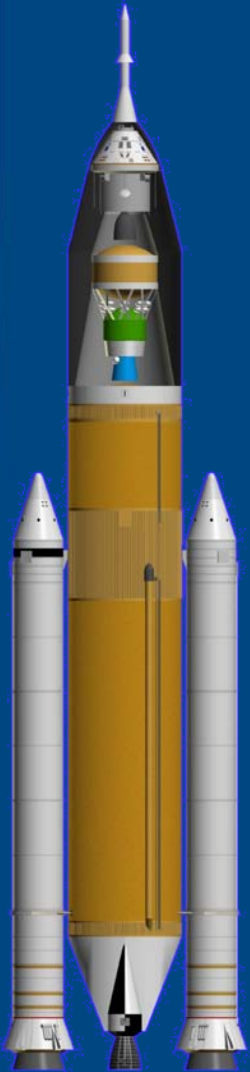


Jupiter Enables an Apollo-8 Mission by 2014





Jupiter Enables an Apollo-8 Mission by 2014





Senior NASA Management Assessment of DIRECT is Wrong

"It's got to get past the performance gate. If it doesn't, it doesn't make sense to look any further."

-Steve Cook (NASA Ares 1 Project Manager) Interview in Space News July 2008

DIRECT 2.0 Space Exploration Architecture Performance Analysis

Marshall Space Flight Center
Analysis Performed: October 2007
May 2009

DIRECT • Space Transportation System Derivative

JUPITER¹²⁰

Rebuttal of NASA's October 2007
DIRECT 2.0 Analysis Findings

18th May 2009

Download at: www.directlauncher.com



Engineering Experts Disagree with Senior NASA Management



"The Jupiter upper stage weight is very reasonable, I would even call it conservative"

*-Bernard Kutter,
Manager of Advance Programs ULA
Popular Mechanics – Feb 09, p 57*

DIRECT

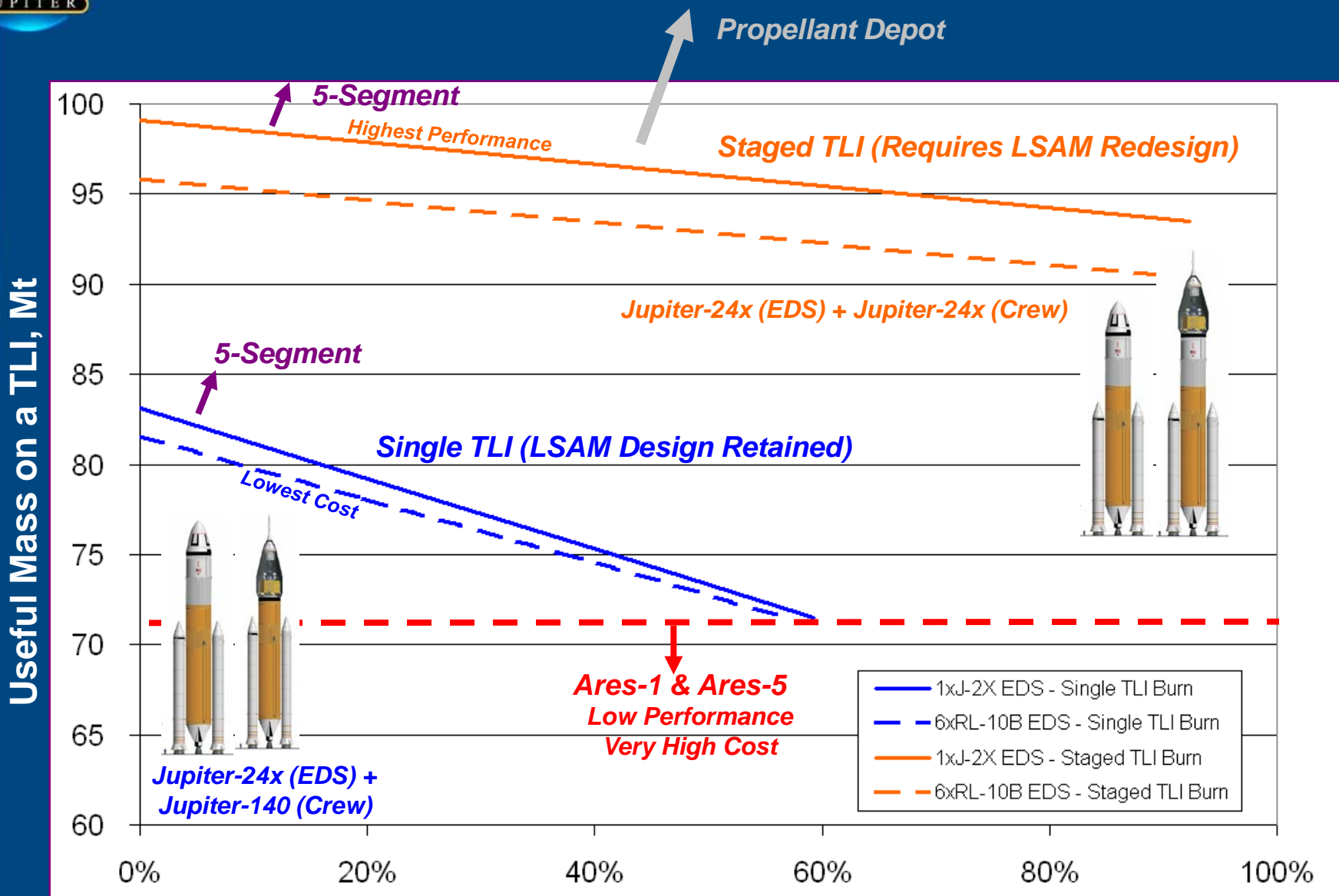
Implements the Policy

Fits the Budget

Has Greater Performance than Ares



DIRECT Performance and Cost Trade Space

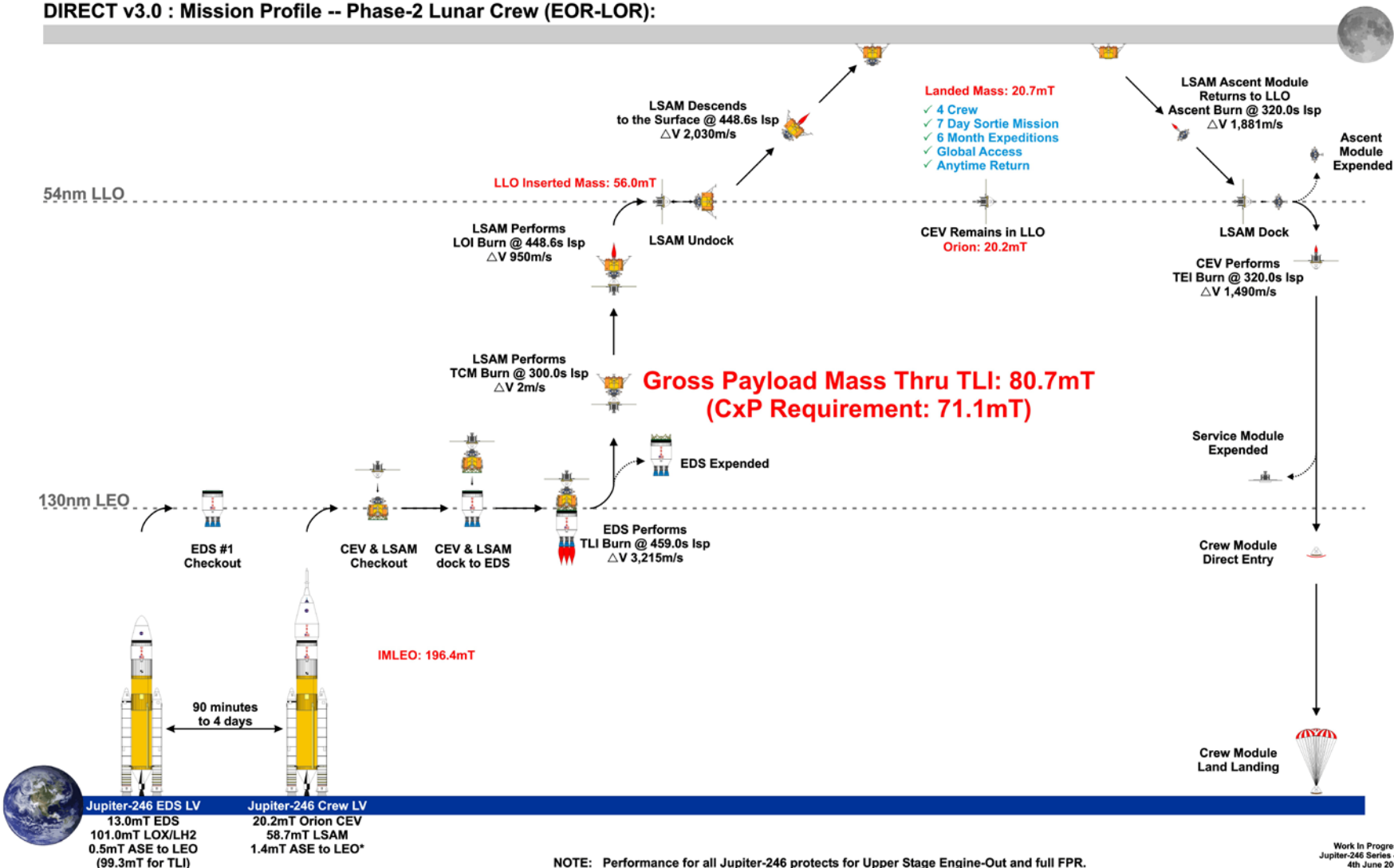


Jupiter Upper Stage Mass Margin over Centaur Class Upper Stage



DIRECT's Phase 2 Baseline EOR-LOR Lunar Architecture

DIRECT v3.0 : Mission Profile -- Phase-2 Lunar Crew (EOR-LOR):

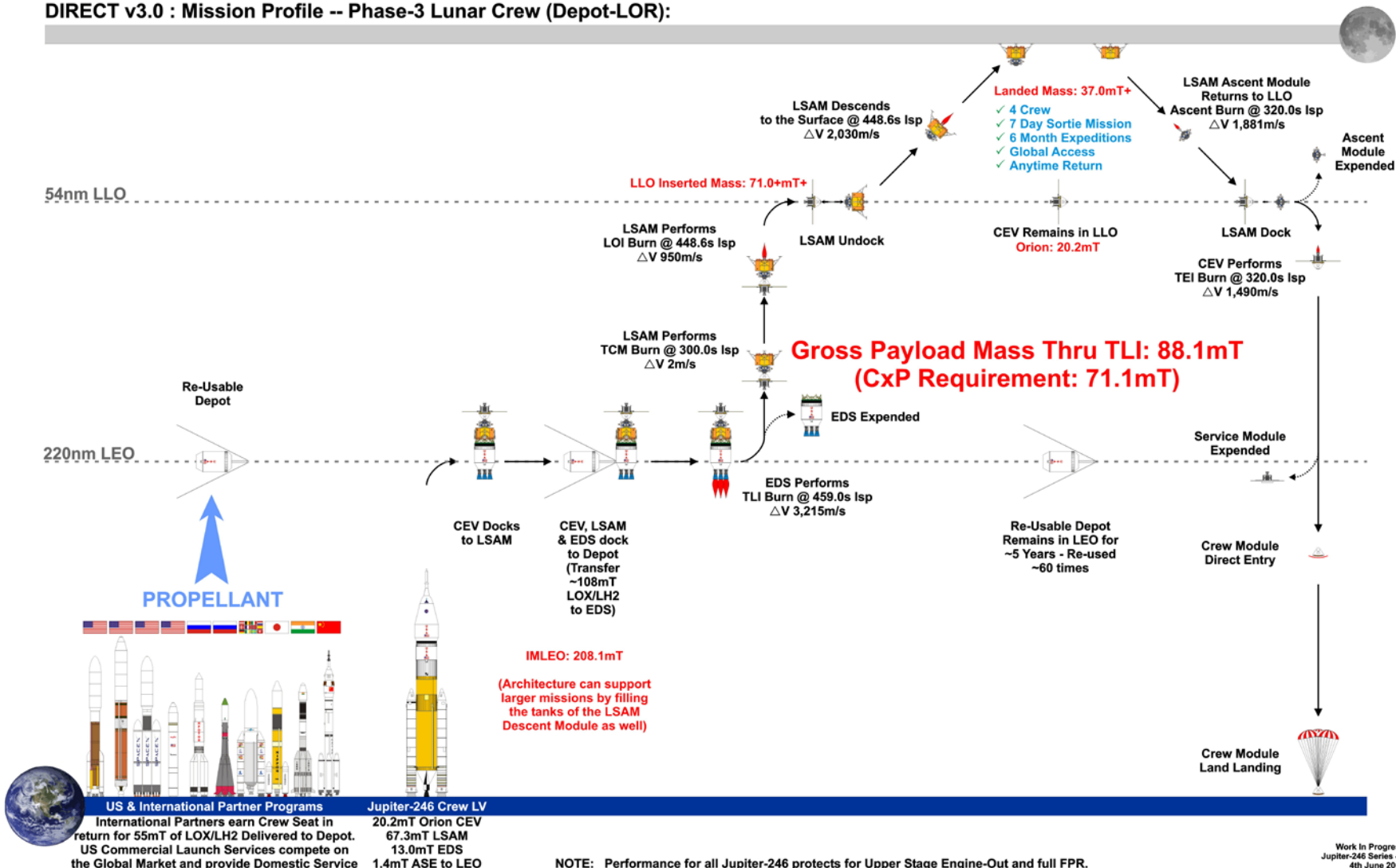


NOTE: Performance for all Jupiter-246 protects for Upper Stage Engine-Out and full FPR.



Expanded Performance via a Propellant Depot Architecture

DIRECT v3.0 : Mission Profile -- Phase-3 Lunar Crew (Depot-LOR):

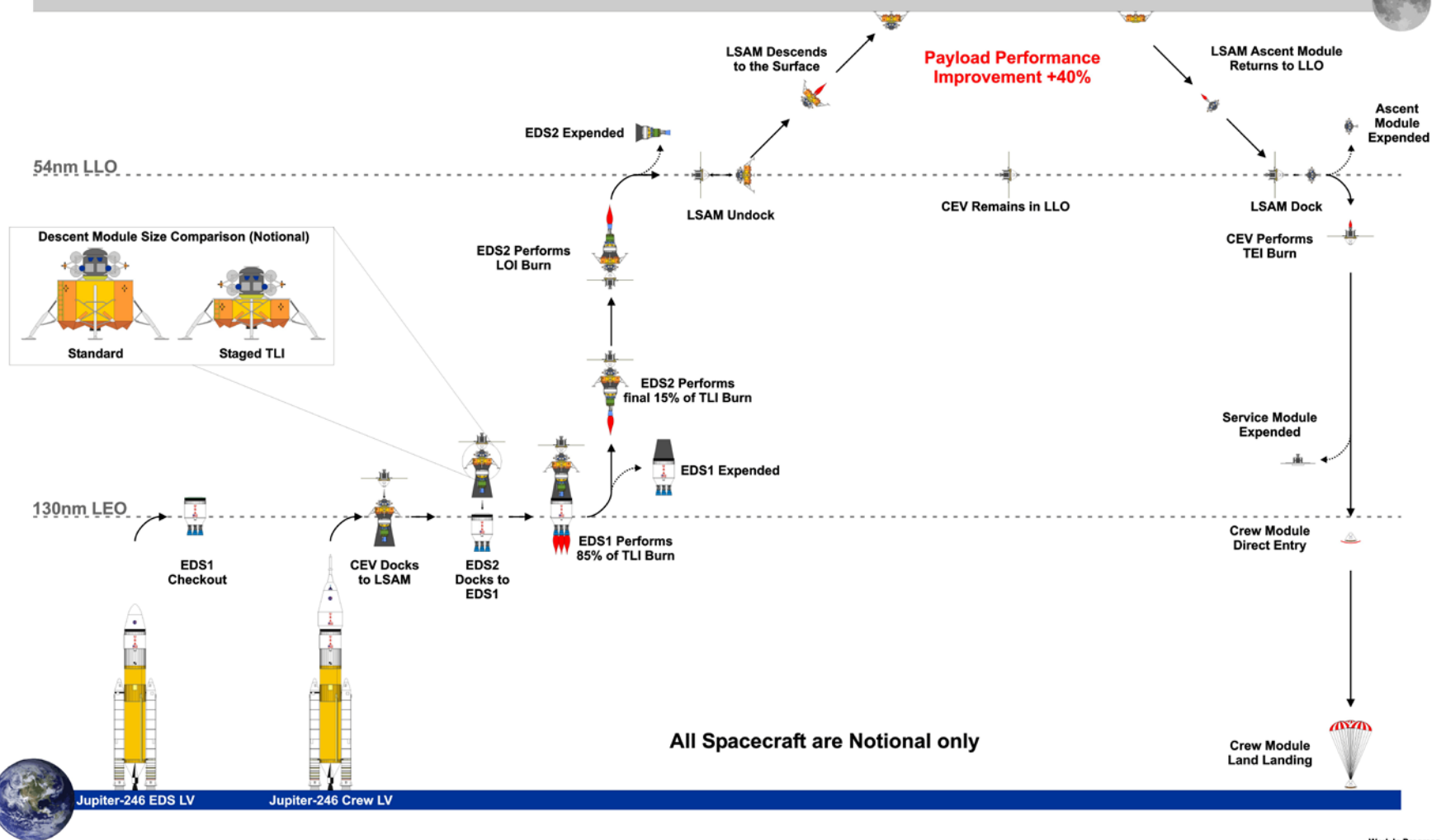


Opens the Door to Both Commercial Launch Services and International Participation



EOR-LOR with Staged TLI

DIRECT v3.0 : Mission Profile -- Optional Architecture: Lunar Crew (Staged-TLI):



NOTE: Performance for all Jupiter-246 protects for Upper Stage Engine-Out and full FPR.

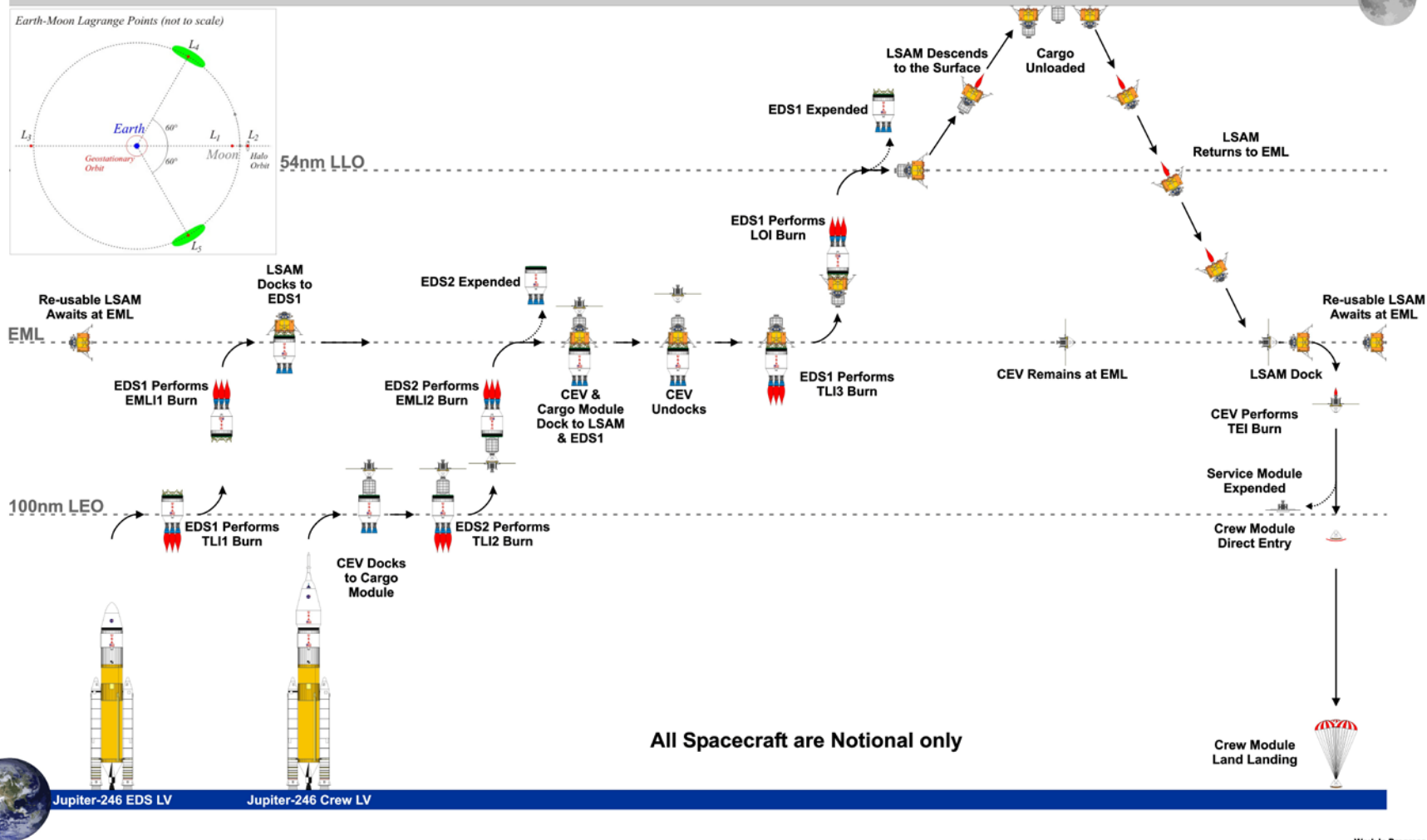
Work In Progress
Jupiter-246 Series 41
4th June 2009

Minimizes Descent Stage Size and maximizes Delivered Payload



EML Architecture

DIRECT v3.0 : Mission Profile -- Optional Architecture: Lunar Crew (EML-1 or EML-2):



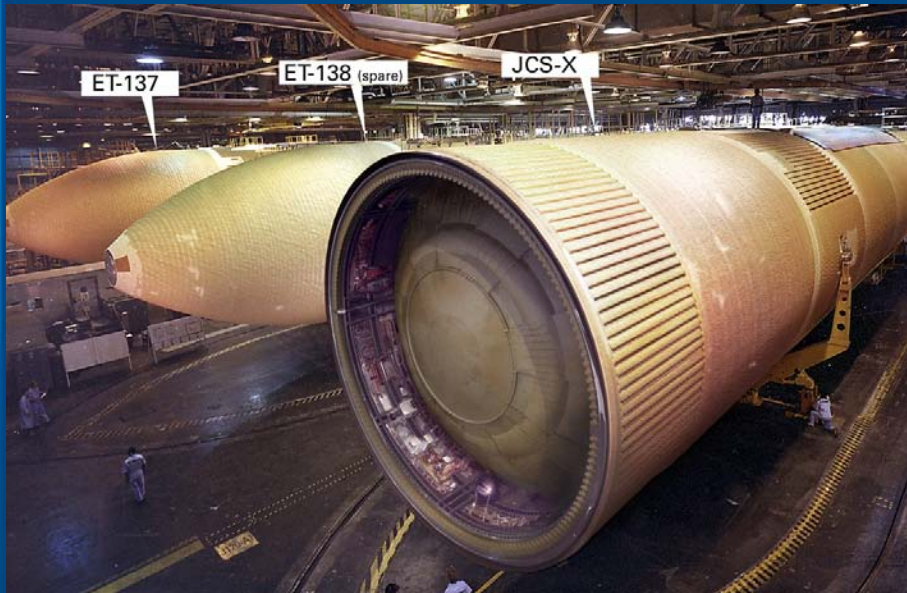
NOTE: Performance for all Jupiter-246 protects for Upper Stage Engine-Out and full FPR.

Work In Progress
Jupiter-246 Series 41
4th June 2009

Optimal Staging Architecture for future Lunar ISRU Propellant Supplies



The Jupiter Core is the Path that Leads to all Better Options



Launch System Options

- Option 1: J-246 CLV + J-246 EDS (SSME/RL-10B-2)
- Option 2: J-244 CLV + J-244 EDS (SSME/RL-60)
- Option 3: J-241 CLV + J-241 EDS (SSME/J-2X)
- Option 4: J-130 CLV + J-246 EDS (SSME/RL-10B-2)
- Option 5: J-130 CLV + J-244 EDS (SSME/RL-60)
- Option 6: J-130 CLV + J-241 EDS (SSME/J-2X)
- Option 7: J-130 Heavy CLV + J-246 Heavy EDS (SSME/RL-10B-2)
- Option 8: J-130 Heavy CLV + J-244 Heavy EDS (SSME/RL-60)
- Option 9: J-130 Heavy CLV + J-241 Heavy EDS (SSME/J-2X)
- Option 10: J-130 Heavy CLV + J-246 Heavy EDS (SSME/RL-10B-2)
- Option 11: J-130 Heavy CLV + J-244 Heavy EDS (SSME/RL-60)
- Option 12: J-130 Heavy CLV + J-241 Heavy EDS (SSME/J-2X)

Spacecraft Options

- i) EDS Performs LOI, LSAM DM is Cryogenic
- ii) LSAM Performs LOI, LSAM DM is Cryogenic
- iii) CEV Performs LOI, LSAM DM is Cryogenic
- iv) EDS Performs LOI, LSAM DM is Hypergolic
- v) LSAM Performs LOI, LSAM DM is Hypergolic
- vi) CEV Performs LOI, LSAM DM is Hypergolic
- vii) Staged Descent

Architecture Options

- A) EOR-LOR
- B) EOR-LOR + Depot
- C) EOR-LOR Staged TLI
- D) EML-1
- E) LOR-LOR
- F) Lunar ISRU
- G) EML-1 + Depot

First Destination Options

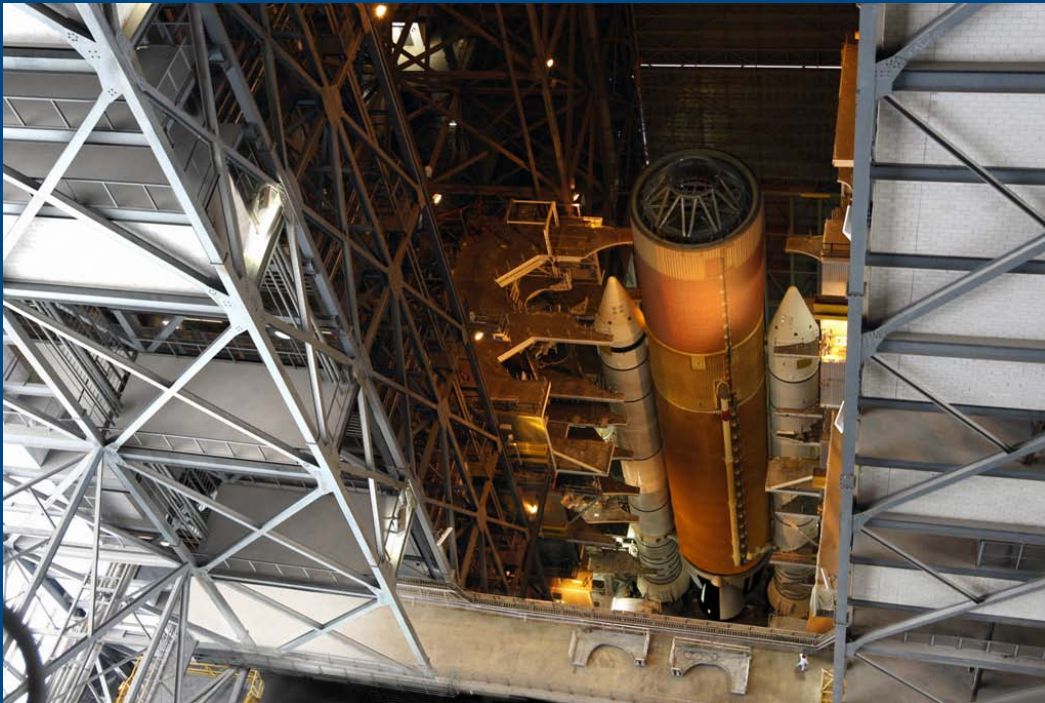
- i) Moon
- ii) Near Earth Object
- iii) Mars Orbit
- iv) Mars Surface

**And All 2,352 Options
- cost less**

**- have higher performance
- can be fielded sooner
Than Ares**



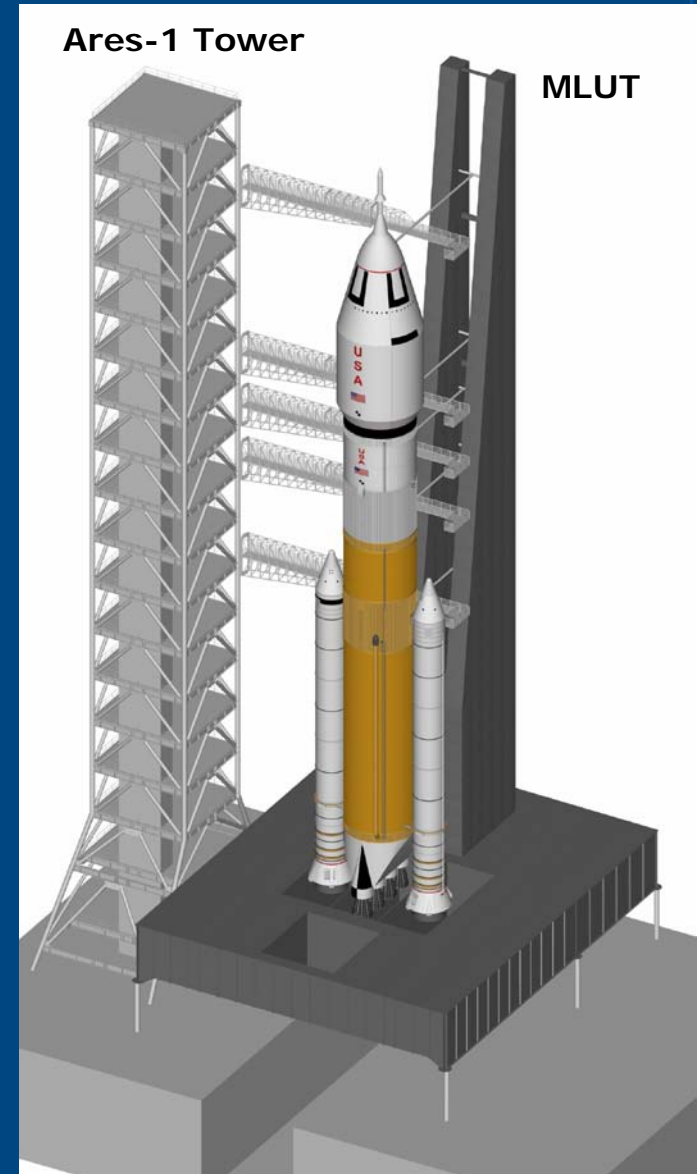
Jupiter Enables an Efficient Clean Pad Approach



Launch system and payload are both fully integrated in the VAB

The Clean Pad approach enables a "14 Days at the Pad" launch cycle

Fixed tower elements already fabricated thanks to Ares-1





Shuttle-C Continues all the Inefficiencies of the Shuttle

Extensive Integration at the Pad

Unsafe Crew Position

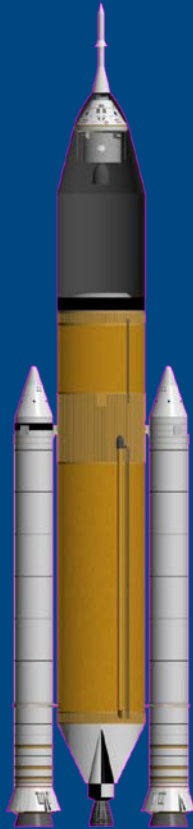
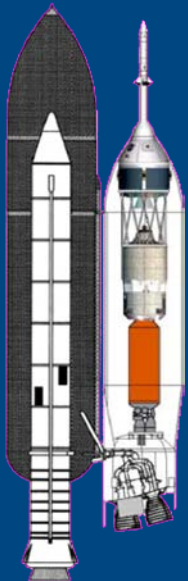
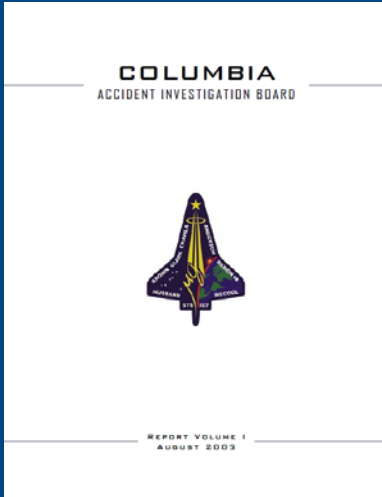
Sub-Orbital Staging Event

Payload Carries the Weight of Orion

Must Human-rate an Upper Stage

Must Human-rate an Upper Stage Engine

Two Different Systems, Core + Side mount





The Critical Decisions before America Right Now

	<i>Ares-I/V</i>	<i>EELV/COTS</i>	<i>DIRECT</i>
<i>Do we continue United States access to the ISS ?</i>	<i>No</i>	<i>Yes</i>	<i>Yes</i>
<i>Do we save the United States' second Heavy Lift system ?</i>	<i>No</i>	<i>No</i>	<i>Yes</i>
<i>Do we remain the leading space faring nation ?</i>	<i>No</i>	<i>No</i>	<i>Yes</i>

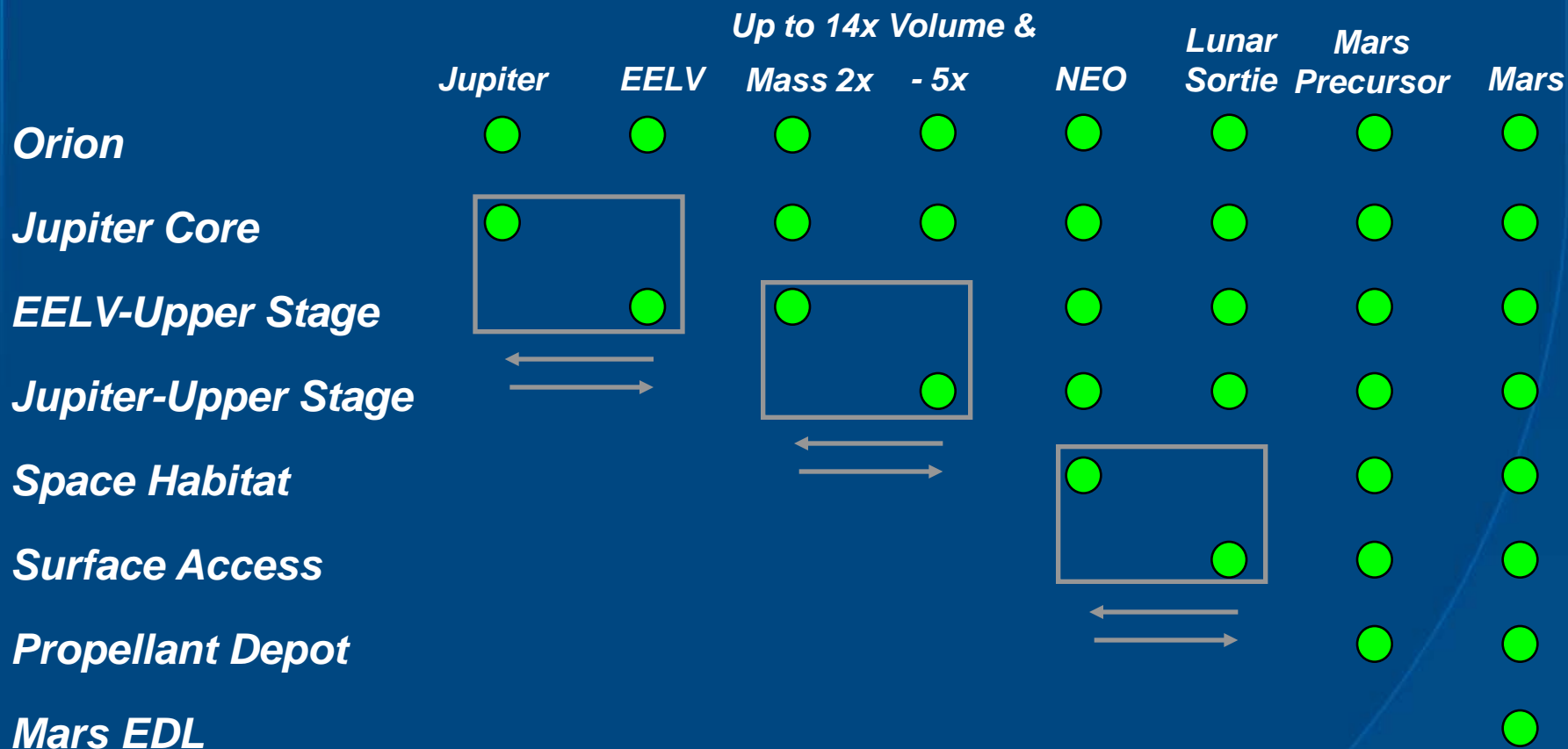


DIRECT Continuously Increases our Exploration Capability

**New ISS
Options**

**New
Missions**

**New
Horizons**





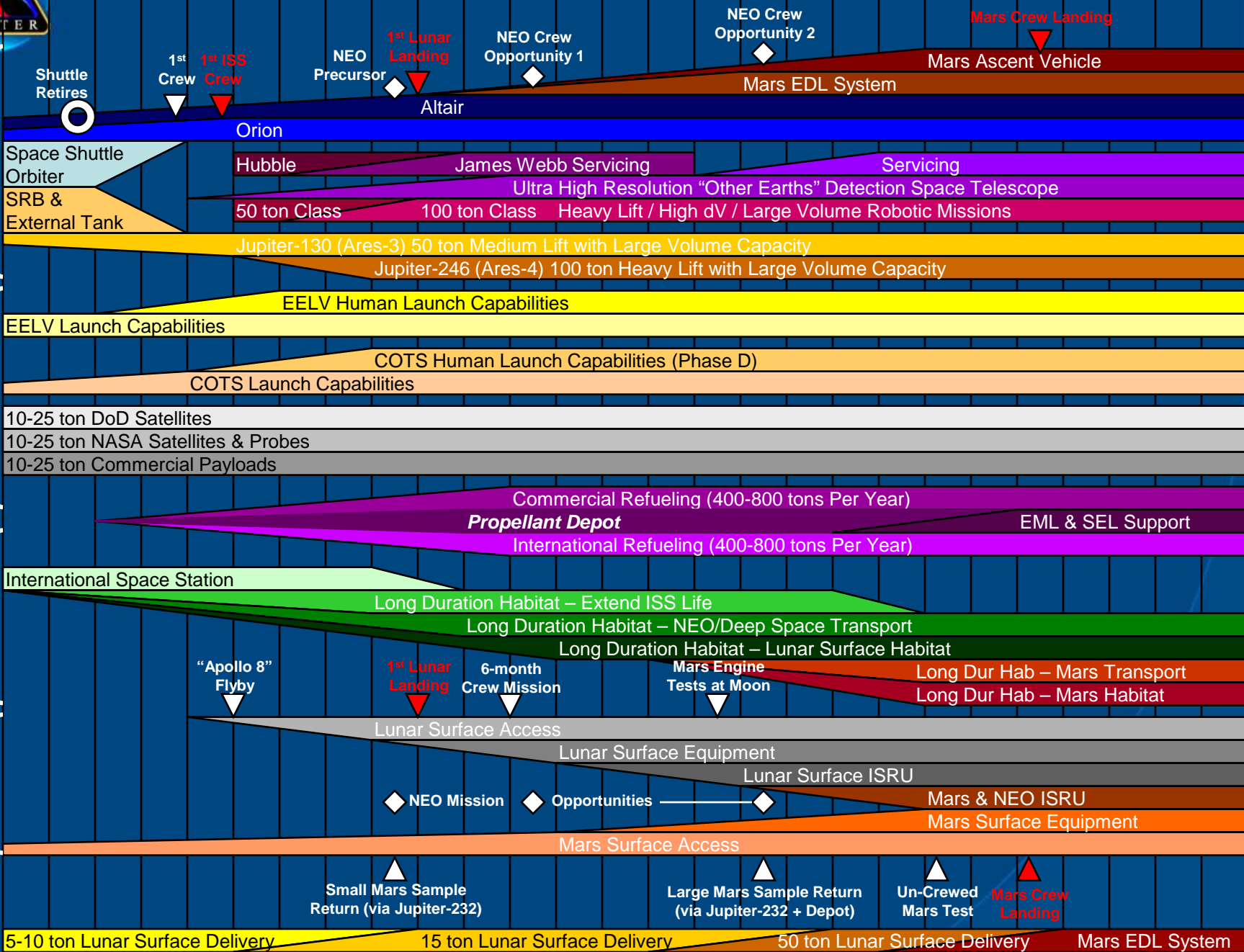
DIRECT Roadmap

09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35

NASA

Commercial

International Exploration





The Next 3 Months will Determine the Next 3 Decades

Fifty years after the Space Age began, America must again answer the same question....

Do we want to be the "world's leading space faring nation"?
- John F. Kennedy

"America is too great for small dreams" - Ronald Reagan



www.directlauncher.com



DIRECT - Phase 1

ISS and LEO Operations

Launch Vehicle Option 1

Jupiter-120

Vehicle Concept Characteristics - LV 41.4000.08100

Launch Site KSC LC-39 (Latitude: 28.6084°)

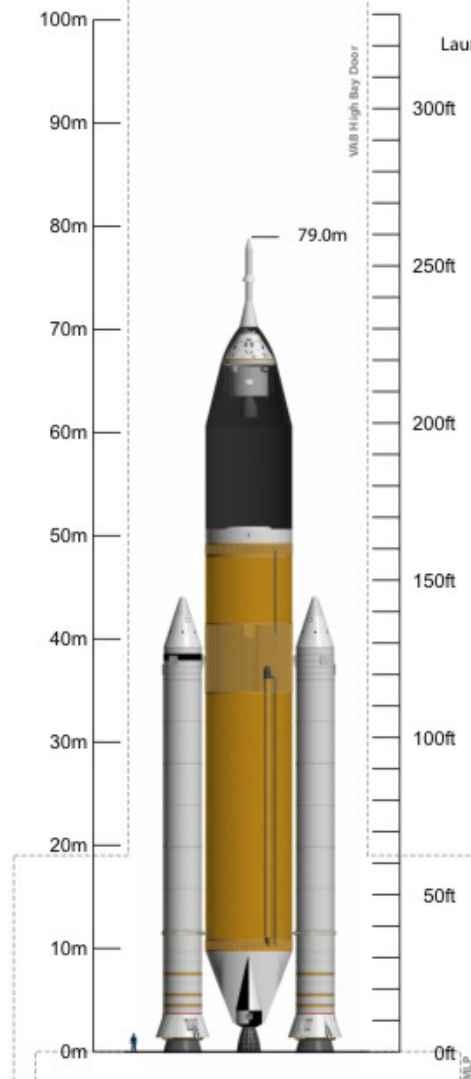
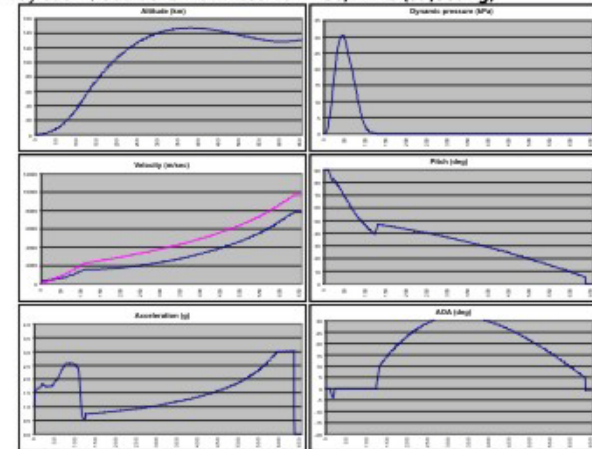
GLOW **4,216,321lb (1,912,491kg)**
 Payload Fairing 27.6 x 32.8ft (8.4 x 10.0m)
 Payload Envelope 25.0 x 32.8ft (7.6 x 10.0m)
 Payload Fairing Jettison Mass 12,365lb (5,609kg)
 Payload Fairing Jettison After Orbital Insertion
 Launch Abort System Jettison Mass 16,083lb (7,295kg)
 Launch Abort System Jettison 319.0s @ 77.3nmi

BOOSTERS (each)
 Design Heritage Shuttle RSRM - Flown Unchanged
 Propellants PBAN
 Usable Propellant 1,111,604lb (504,215kg)
 Stage pmf 0.8561
 Dry Mass 183,948lb (83,437kg)
 Burnout Mass 186,864lb (84,760kg)
 # Boosters / Type 2 / 4-segment Shuttle RSRM
 Booster Thrust (@ 0.7s) SL 2,892,912lbf (1,312,203kgf / 12,868,314N)
 Vac 3,142,302lbf (1,425,324kgf / 13,977,656N)
 Booster Isp (@ 0.7s) SL 237.0s
 Vac 269.1s
 Booster Burn Time 123.8s

CORE STAGE
 Design Heritage Shuttle Super Light Weight Tank ET
 Propellants LOX / LH2
 Gross Propellant 1,621,191lb (735,360kg)
 Usable Ascent Propellant 1,604,979lb (728,006kg)
 Unusable Residuals 16,047lb (7,279kg)
 In-Flight Losses 325lb (147kg)
 Propellant Offload 16.30%
 Stage pmf 0.8988
 Dry Mass 133,499lb (60,554kg)
 Burnout Mass 149,546lb (67,833kg)
 # Engines / Type 2 / SSME-Block-II
 Engine Thrust (@ 104.5%) SL 392,326lbf (177,956kgf / 1,745,155N)
 Vac 490,847lbf (222,644kgf / 2,183,396N)
 Engine Isp (@ 104.5%) SL 361.4s
 Vac 452.2s
 Mission Power Level 104.5%
 Core Burn Time 637.7s

DYNAMICS
 Thrust : Weight @ Liftoff 1.558 : 1
 Max Dynamic Pressure 636.6psf (30,482Pa)
 Max g's During Ascent 3.00g
 Insertion Altitude 70.0nmi (129.7km)

ASCENT PERFORMANCE
 Delivery Orbit 30.0 x 100.0nmi, 51.6°
 Payload w/ regular NASA GR&A's 96,363lb (43,709kg)
 Payload w/ additional 10% Reserve **86,727lb (39,339kg)**



Work In Progress
 6th June 2009

* ASE is part of the Payload, not additional

Vehicle Concept Characteristics - LV 41.5000.08100

Launch Site KSC LC-39 (Latitude: 28.6084°)

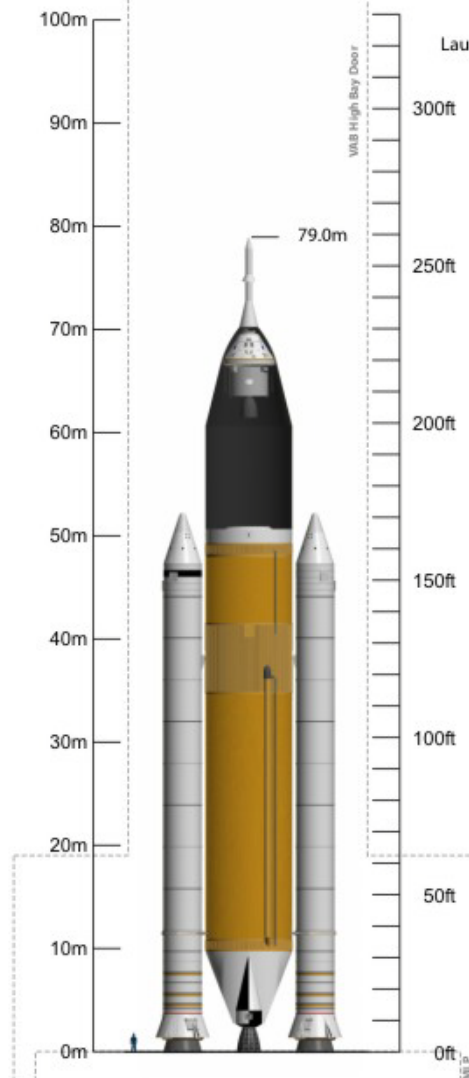
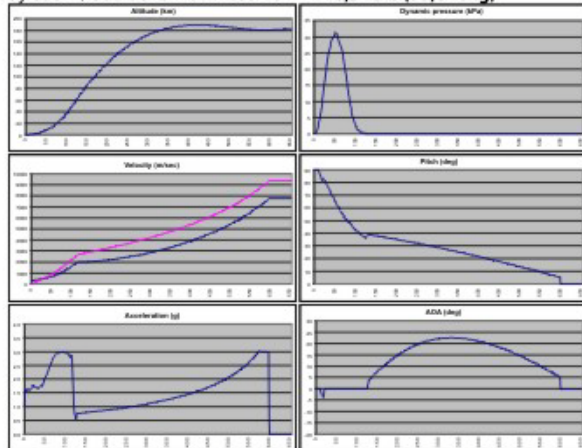
GLOW 5,068,908lb (2,299,218kg)
 Payload Fairing 27.6 x 32.8ft (8.4 x 10.0m)
 Payload Envelope 25.0 x 32.8ft (7.6 x 10.0m)
 Payload Fairing Jettison Mass 12,365lb (5,609kg)
 Payload Fairing Jettison After Orbital Insertion
 Launch Abort System Jettison Mass 16,083lb (7,295kg)
 Launch Abort System Jettison 300.5s @ 92.8nmi

BOOSTERS (each)
 Design Heritage Shuttle-derived 5-segment RSRMV
 Propellants PBAN
 Usable Propellant 1,380,873lb (626,353kg)
 Stage pmf 0.8656
 Dry Mass 228,620lb (103,700kg)
 Burnout Mass 232,608lb (105,509kg)
 # Boosters / Type 2 / 5-segment RSRMV
 Booster Thrust (@ 0.7s) SL 3,510,791lbf (1,592,468kgf / 15,616,776N)
 Vac 3,510,791lbf (1,592,468kgf / 15,616,776N)
 Booster Isp (@ 0.7s) SL 237.0s
 Vac 267.4s
 Booster Burn Time 126.6s

CORE STAGE
 Design Heritage Shuttle Super Light Weight Tank ET
 Propellants LOX / LH2
 Gross Propellant 1,621,191lb (735,360kg)
 Usable Ascent Propellant 1,604,979lb (728,006kg)
 Unusable Residuals 16,047lb (7,279kg)
 In-Flight Losses 325lb (147kg)
 Propellant Offload 20.91%
 Stage pmf 0.8935
 Dry Mass 133,499lb (60,554kg)
 Burnout Mass 149,546lb (67,833kg)
 # Engines / Type 2 / SSME-Block-II
 Engine Thrust (@ 104.5%) SL 392,326lbf (177,956kgf / 1,745,155N)
 Vac 490,847lbf (222,644kgf / 2,183,396N)
 Engine Isp (@ 104.5%) SL 361.4s
 Vac 452.2s
 Mission Power Level 104.5%
 Core Burn Time 600.1s

DYNAMICS
 Thrust : Weight @ Liftoff 1.561 : 1
 Max Dynamic Pressure 652.7psf (31,253Pa)
 Max g's During Ascent 3.00g
 Insertion Altitude 97.5nmi (180.6km)

ASCENT PERFORMANCE
 Delivery Orbit 30.0 x 100.0nmi, 51.6°
 Payload w/ regular NASA GR&A's 129,940lb (58,940kg)
 Payload w/ additional 10% Reserve **116,946lb (53,046kg)**



Work In Progress
 8th June 2009

* ASE is part of the Payload, not additional



DIRECT - Phase 1

ISS and LEO Operations

Launch Vehicle Option 2
(Recommended)

Jupiter-130

Vehicle Concept Characteristics - LV 41.4000.08100

Launch Site KSC LC-39 (Latitude: 28.6084°)

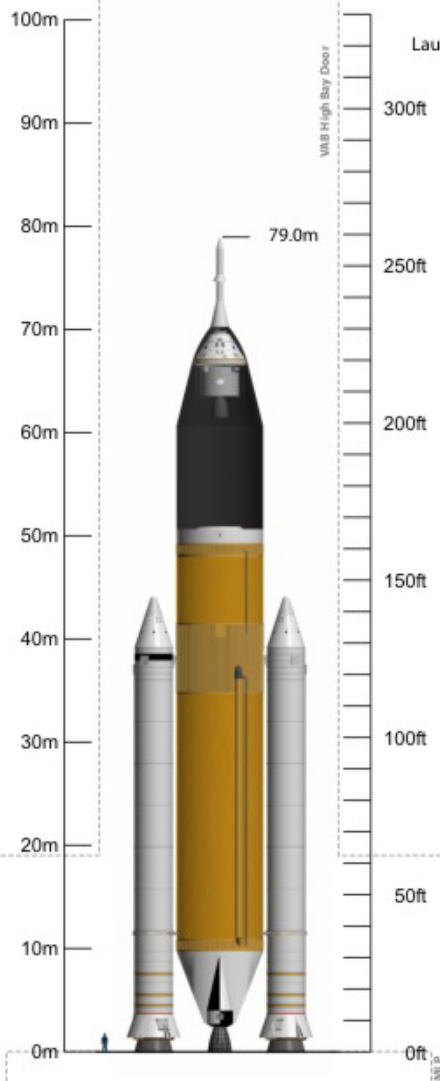
GLOW	4,559,350lb (2,068,086kg)
Payload Fairing	27.6 x 32.8ft (8.4 x 10.0m)
Payload Envelope	25.0 x 32.8ft (7.6 x 10.0m)
Payload Fairing Jettison Mass	12,365lb (5,609kg)
Payload Fairing Jettison	After Orbital Insertion
Launch Abort System Jettison Mass	16,083lb (7,295kg)
Launch Abort System Jettison	259.0s @ 58.0nmi

BOOSTERS (each)

Design Heritage	Shuttle RSRM - Flown Unchanged
Propellants	PBAN
Usable Propellant	1,111,604lb (504,215kg)
Stage pmf	0.8561
Dry Mass	183,948lb (83,437kg)
Burnout Mass	186,864lb (84,760kg)
# Boosters / Type	2 / 4-segment Shuttle RSRM
Booster Thrust (@ 0.7s) SL	2,892,912lbf (1,312,203kgf / 12,868,314N)
Vac	3,142,302lbf (1,425,324kgf / 13,977,656N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	269.1s
Booster Burn Time	123.8s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9107
Dry Mass	140,489lb (63,725kg)
Burnout Mass	156,536lb (71,004kg)
# Engines / Type	3 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	517.1s

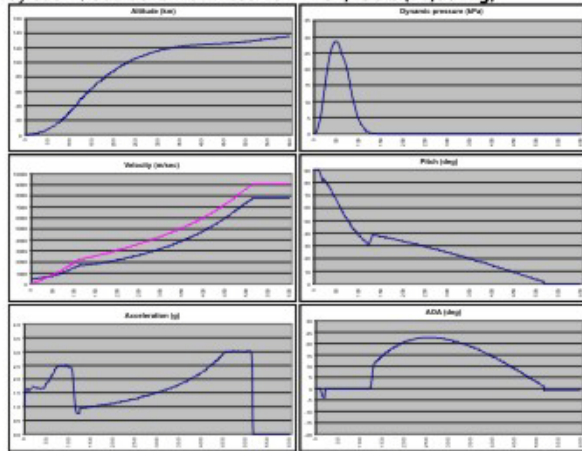


DYNAMICS

Thrust : Weight @ Liftoff	1.527 : 1
Max Dynamic Pressure	597.1psf (28,590Pa)
Max g's During Ascent	3.00g
Insertion Altitude	70.0nmi (129.6km)

ASCENT PERFORMANCE

Delivery Orbit	30.0 x 100.0nmi, 29.0°
Payload w/ regular NASA GR&A's	171,596lb (77,835kg)
Payload w/ additional 10% Reserve	154,436lb (70,051kg)



Work In Progress

6th June 2009

* ASE is part of the Payload, not additional

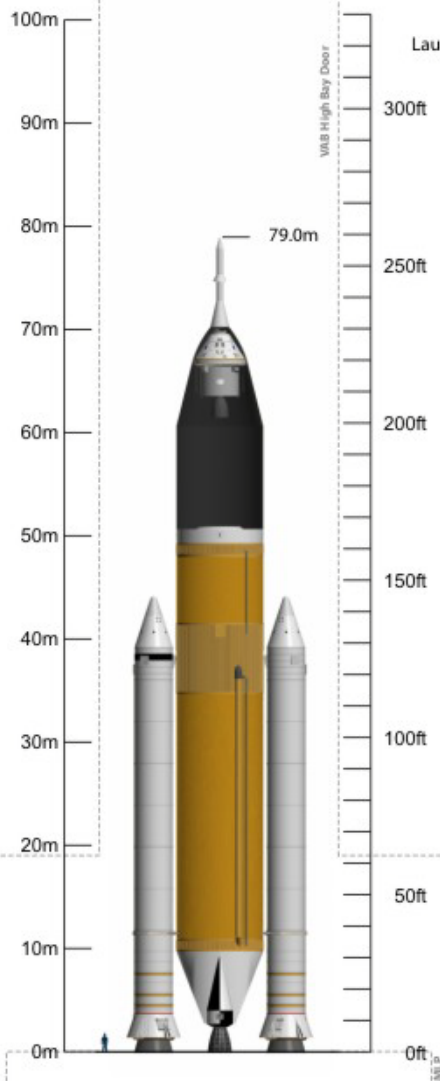
Vehicle Concept Characteristics - LV 41.4000.08100

Launch Site KSC LC-39 (Latitude: 28.6084°)

GLOW 4,547,532lb (2,062,726kg)
 Payload Fairing 27.6 x 32.8ft (8.4 x 10.0m)
 Payload Envelope 25.0 x 32.8ft (7.6 x 10.0m)
 Payload Fairing Jettison Mass 12,365lb (5,609kg)
 Payload Fairing Jettison After Orbital Insertion
 Launch Abort System Jettison Mass 16,083lb (7,295kg)
 Launch Abort System Jettison 260.5s @ 58.6nmi

BOOSTERS (each)
 Design Heritage Shuttle RSRM - Flown Unchanged
 Propellants PBAN
 Usable Propellant 1,111,604lb (504,215kg)
 Stage pmf 0.8561
 Dry Mass 183,948lb (83,437kg)
 Burnout Mass 186,864lb (84,760kg)
 # Boosters / Type 2 / 4-segment Shuttle RSRM
 Booster Thrust (@ 0.7s) SL 2,892,912lbf (1,312,203kgf / 12,868,314N)
 Vac 3,142,302lbf (1,425,324kgf / 13,977,656N)
 Booster Isp (@ 0.7s) SL 237.0s
 Vac 269.1s
 Booster Burn Time 123.8s

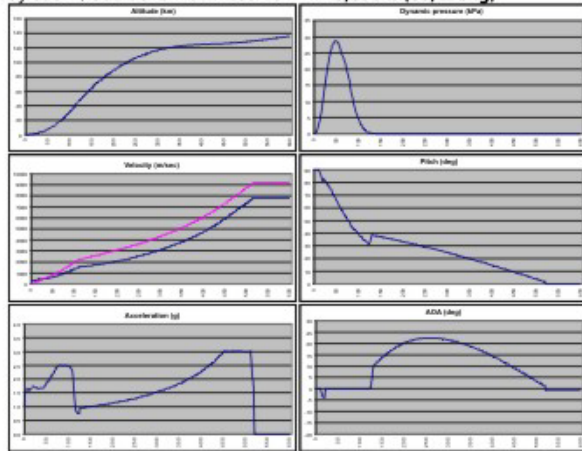
CORE STAGE
 Design Heritage Shuttle Super Light Weight Tank ET
 Propellants LOX / LH2
 Gross Propellant 1,621,191lb (735,360kg)
 Usable Ascent Propellant 1,604,979lb (728,006kg)
 Unusable Residuals 16,047lb (7,279kg)
 In-Flight Losses 325lb (147kg)
 Propellant Offload 0.00%
 Stage pmf 0.9107
 Dry Mass 140,489lb (63,725kg)
 Burnout Mass 156,536lb (71,004kg)
 # Engines / Type 3 / SSME-Block-II
 Engine Thrust (@ 104.5%) SL 392,326lbf (177,956kgf / 1,745,155N)
 Vac 490,847lbf (222,644kgf / 2,183,396N)
 Engine Isp (@ 104.5%) SL 361.4s
 Vac 452.2s
 Mission Power Level 104.5%
 Core Burn Time 520.9s



DYNAMICS
 Thrust : Weight @ Liftoff 1.531 : 1
 Max Dynamic Pressure 599.5psf (28,705Pa)
 Max g's During Ascent 3.00g
 Insertion Altitude 70.0nmi (129.6km)

Blackzone Safe Trajectory
 1.531 : 1
 599.5psf (28,705Pa)
 3.00g
 70.0nmi (129.6km)

ASCENT PERFORMANCE
 Delivery Orbit 30.0 x 100.0nmi, 51.6°
 Payload w/ regular NASA GR&A's 159,777lb (72,474kg)
 Payload w/ additional 10% Reserve 143,800lb (65,226kg)



Work In Progress
 6th June 2009

* ASE is part of the Payload, not additional

Vehicle Concept Characteristics - LV 41.4000.08100

Launch Site KSC LC-39 (Latitude: 28.6084°)

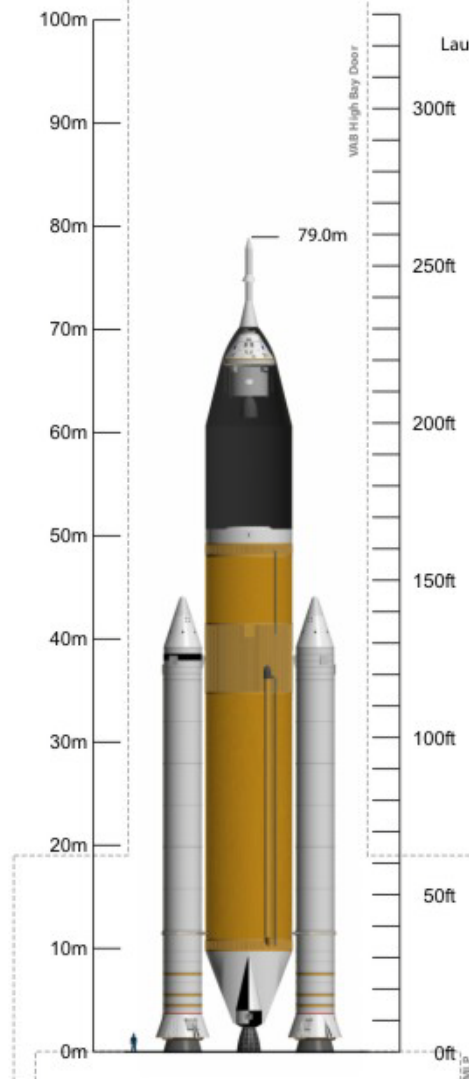
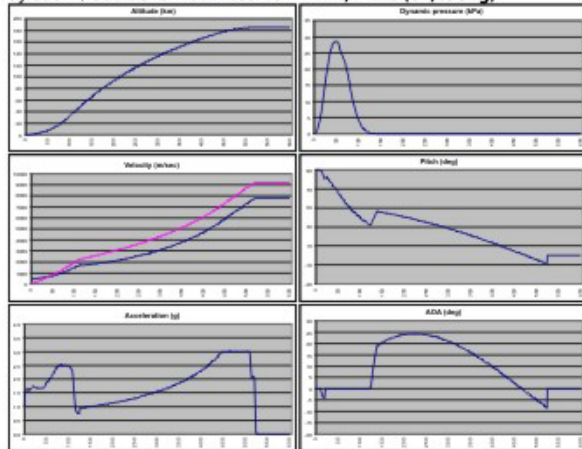
GLOW 4,545,245lb (2,061,689kg)
 Payload Fairing 27.6 x 32.8ft (8.4 x 10.0m)
 Payload Envelope 25.0 x 32.8ft (7.6 x 10.0m)
 Payload Fairing Jettison Mass 12,365lb (5,609kg)
 Payload Fairing Jettison After Orbital Insertion
 Launch Abort System Jettison Mass 16,083lb (7,295kg)
 Launch Abort System Jettison 262.5s @ 65.3nmi

BOOSTERS (each)
 Design Heritage Shuttle RSRM - Flown Unchanged
 Propellants PBAN
 Usable Propellant 1,111,604lb (504,215kg)
 Stage pmf 0.8561
 Dry Mass 183,948lb (83,437kg)
 Burnout Mass 186,864lb (84,760kg)
 # Boosters / Type 2 / 4-segment Shuttle RSRM
 Booster Thrust (@ 0.7s) SL 2,892,912lbf (1,312,203kgf / 12,868,314N)
 Vac 3,142,302lbf (1,425,324kgf / 13,977,656N)
 Booster Isp (@ 0.7s) SL 237.0s
 Vac 269.1s
 Booster Burn Time 123.8s

CORE STAGE
 Design Heritage Shuttle Super Light Weight Tank ET
 Propellants LOX / LH2
 Gross Propellant 1,621,191lb (735,360kg)
 Usable Ascent Propellant 1,604,979lb (728,006kg)
 Unusable Residuals 16,047lb (7,279kg)
 In-Flight Losses 325lb (147kg)
 Propellant Offload 0.00%
 Stage pmf 0.9107
 Dry Mass 140,489lb (63,725kg)
 Burnout Mass 156,536lb (71,004kg)
 # Engines / Type 3 / SSME-Block-II
 Engine Thrust (@ 104.5%) SL 392,326lbf (177,956kgf / 1,745,155N)
 Vac 490,847lbf (222,644kgf / 2,183,396N)
 Engine Isp (@ 104.5%) SL 361.4s
 Vac 452.2s
 Mission Power Level 104.5%
 Core Burn Time 524.5s

DYNAMICS
 Thrust : Weight @ Liftoff 1.532 : 1
 Max Dynamic Pressure 600.0psf (28,729Pa)
 Max g's During Ascent 3.00g
 Insertion Altitude 100.0nmi (185.2km)

ASCENT PERFORMANCE
 Delivery Orbit 100.0 x 100.0nmi, 29.0°
 Payload w/ regular NASA GR&A's 157,491lb (71,437kg)
 Payload w/ additional 10% Reserve 141,742lb (64,293kg)



Work In Progress
 6th June 2009

* ASE is part of the Payload, not additional

Vehicle Concept Characteristics - LV 41.4000.08100

Launch Site KSC LC-39 (Latitude: 28.6084°)

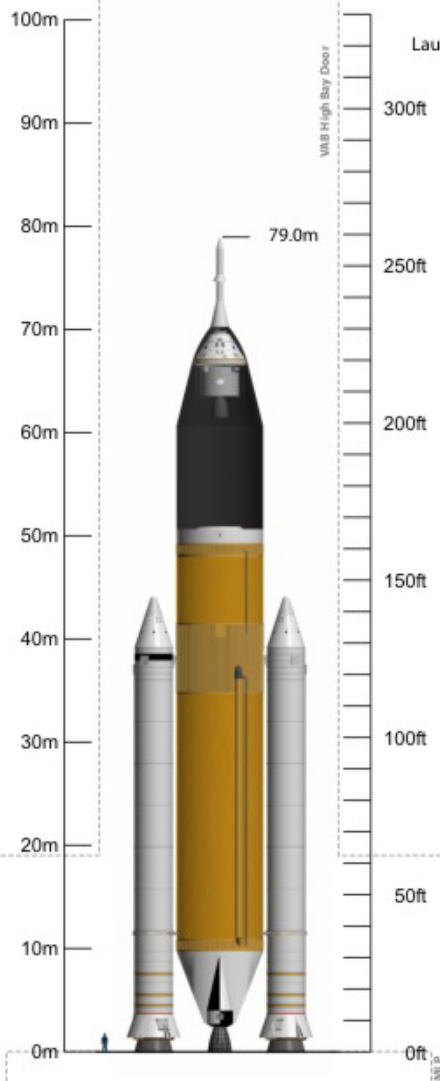
GLOW	4,535,420lb (2,057,232kg)
Payload Fairing	27.6 x 32.8ft (8.4 x 10.0m)
Payload Envelope	25.0 x 32.8ft (7.6 x 10.0m)
Payload Fairing Jettison Mass	12,365lb (5,609kg)
Payload Fairing Jettison	After Orbital Insertion
Launch Abort System Jettison Mass	16,083lb (7,295kg)
Launch Abort System Jettison	264.0s @ 66.0nmi

BOOSTERS (each)

Design Heritage	Shuttle RSRM - Flown Unchanged
Propellants	PBAN
Usable Propellant	1,111,604lb (504,215kg)
Stage pmf	0.8561
Dry Mass	183,948lb (83,437kg)
Burnout Mass	186,864lb (84,760kg)
# Boosters / Type	2 / 4-segment Shuttle RSRM
Booster Thrust (@ 0.7s) SL	2,892,912lbf (1,312,203kgf / 12,868,314N)
Vac	3,142,302lbf (1,425,324kgf / 13,977,656N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	269.1s
Booster Burn Time	123.8s

CORE STAGE

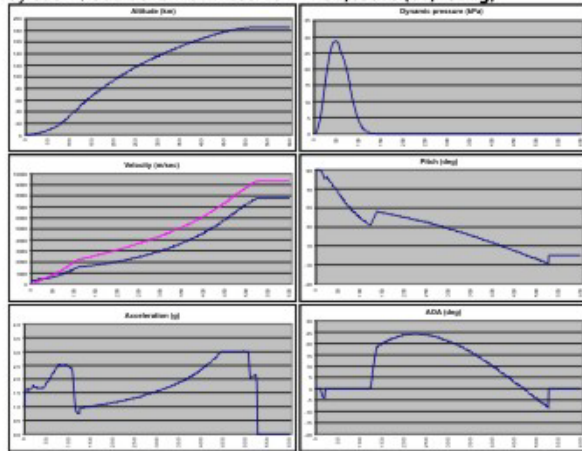
Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9107
Dry Mass	140,489lb (63,725kg)
Burnout Mass	156,536lb (71,004kg)
# Engines / Type	3 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	527.6s



DYNAMICS	Blackzone Safe Trajectory
Thrust : Weight @ Liftoff	1.535 : 1
Max Dynamic Pressure	602.0psf (28,823Pa)
Max g's During Ascent	3.00g
Insertion Altitude	100.0nmi (185.2km)

ASCENT PERFORMANCE

Delivery Orbit	100.0 x 100.0nmi, 51.6°
Payload w/ regular NASA GR&A's	147,666lb (66,980kg)
Payload w/ additional 10% Reserve	132,899lb (60,282kg)



Work In Progress
6th June 2009

* ASE is part of the Payload, not additional

Vehicle Concept Characteristics - LV 41.4000.10050

Launch Site KSC LC-39 (Latitude: 28.6084°)

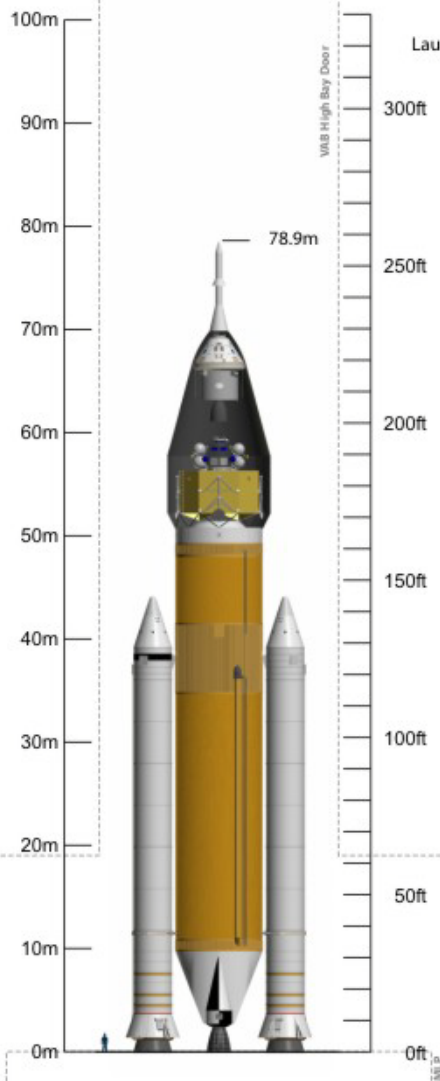
GLOW	4,558,182lb (2,067,556kg)
Payload Fairing	32.8 x 18.4ft (10.0 x 5.6m)
Payload Envelope	30.2 x 18.4ft (9.2 x 5.6m)
Payload Fairing Jettison Mass	12,571lb (5,702kg)
Payload Fairing Jettison	After Orbital Insertion
Launch Abort System Jettison Mass	16,083lb (7,295kg)
Launch Abort System Jettison	259.0s @ 57.9nmi

BOOSTERS (each)

Design Heritage	Shuttle RSRM - Flown Unchanged
Propellants	PBAN
Usable Propellant	1,111,604lb (504,215kg)
Stage pmf	0.8561
Dry Mass	183,948lb (83,437kg)
Burnout Mass	186,864lb (84,760kg)
# Boosters / Type	2 / 4-segment Shuttle RSRM
Booster Thrust (@ 0.7s) SL	2,892,912lbf (1,312,203kgf / 12,868,314N)
Vac	3,142,302lbf (1,425,324kgf / 13,977,656N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	269.1s
Booster Burn Time	123.8s

CORE STAGE

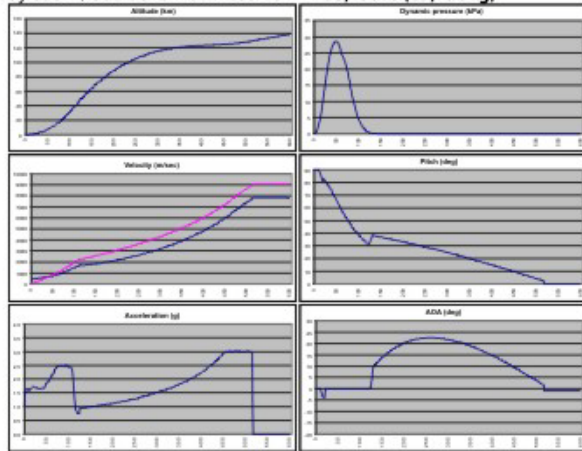
Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9107
Dry Mass	140,489lb (63,725kg)
Burnout Mass	156,536lb (71,004kg)
# Engines / Type	3 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	517.1s



DYNAMICS	Blackzone Safe Trajectory
Thrust : Weight @ Liftoff	1.528 : 1
Max Dynamic Pressure	597.4psf (28,602Pa)
Max g's During Ascent	3.00g
Insertion Altitude	70.0nmi (129.6km)

ASCENT PERFORMANCE

Delivery Orbit	30.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	170,221lb (77,211kg)
Payload w/ additional 10% Reserve	153,199lb (69,490kg)

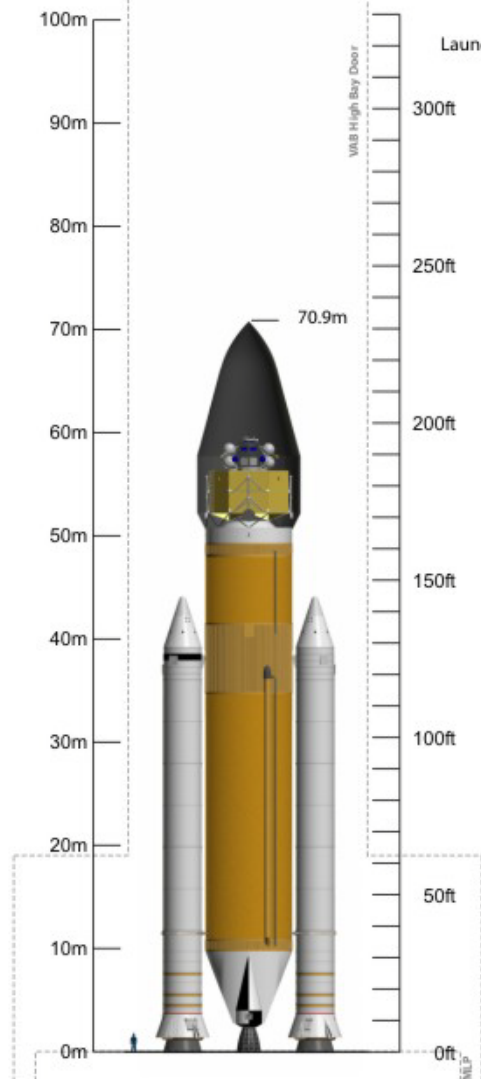
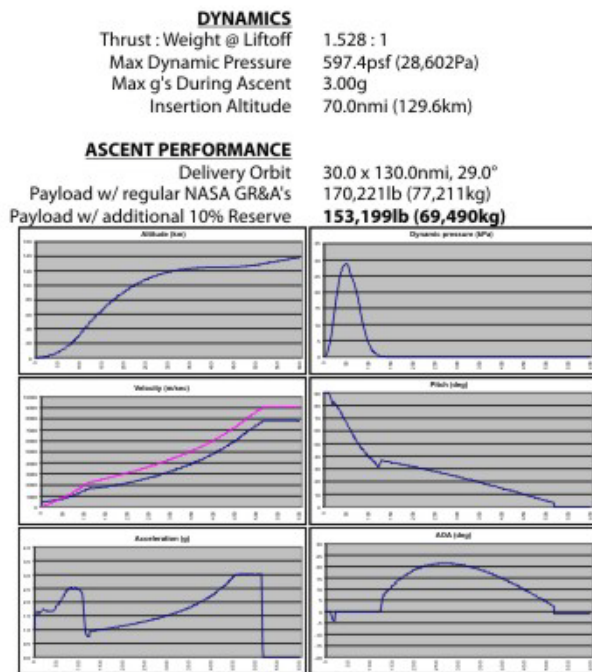


Work In Progress

8th June 2009

* ASE is part of the Payload, not additional

Vehicle Concept Characteristics - LV 41.4000.10051



Launch Site KSC LC-39 (Latitude: 28.6084°)

GLOW	4,558,182lb (2,067,556kg)
Payload Fairing	32.8 x 18.4ft (10.0 x 5.6m)
Payload Envelope	30.2 x 18.4ft (9.2 x 5.6m)
Payload Fairing Jettison Mass	12,571lb (5,702kg)
Payload Fairing Jettison	After Orbital Insertion
Launch Abort System Jettison Mass	16,083lb (7,295kg)
Launch Abort System Jettison	259.0s @ 57.9nmi
BOOSTERS (each)	
Design Heritage	Shuttle RSRM - Flown Unchanged
Propellants	PBAN
Usable Propellant	1,111,604lb (504,215kg)
Stage pmf	0.8561
Dry Mass	183,948lb (83,437kg)
Burnout Mass	186,864lb (84,760kg)
# Boosters / Type	2 / 4-segment Shuttle RSRM
Booster Thrust (@ 0.7s) SL	2,892,912lbf (1,312,203kgf / 12,868,314N)
Vac	3,142,302lbf (1,425,324kgf / 13,977,656N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	269.1s
Booster Burn Time	123.8s
CORE STAGE	
Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9107
Dry Mass	140,489lb (63,725kg)
Burnout Mass	156,536lb (71,004kg)
# Engines / Type	3 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	517.1s

Work In Progress
6th June 2009

* ASE is part of the Payload, not additional



DIRECT - Phase 1

ISS and LEO Operations

Launch Vehicle Option 3

Jupiter-120 Heavy



DIRECT - Phase 1

ISS and LEO Operations

Launch Vehicle Option 4

Jupiter-130 Heavy

Vehicle Concept Characteristics - LV 41.5000.08100

Launch Site KSC LC-39 (Latitude: 28.6084°)

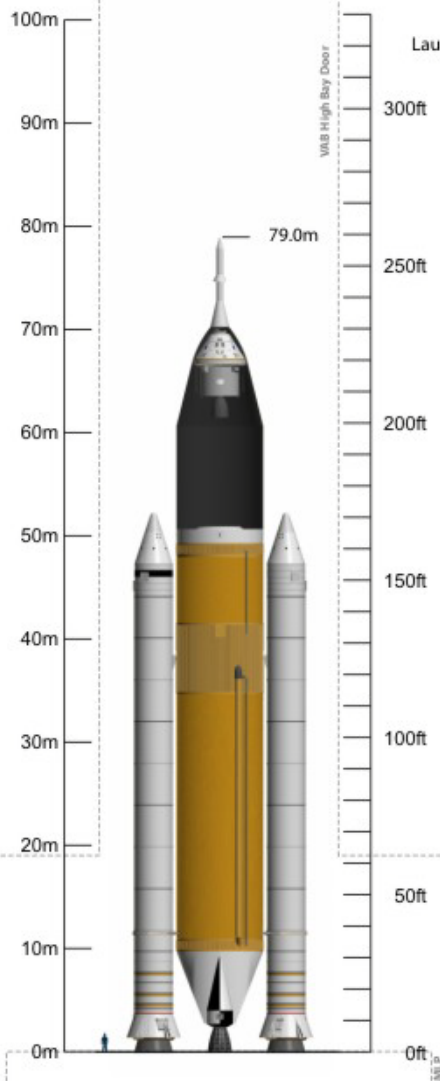
GLOW	5,489,389lb (2,489,945kg)
Payload Fairing	27.6 x 32.8ft (8.4 x 10.0m)
Payload Envelope	25.0 x 32.8ft (7.6 x 10.0m)
Payload Fairing Jettison Mass	12,365lb (5,609kg)
Payload Fairing Jettison	After Orbital Insertion
Launch Abort System Jettison Mass	16,083lb (7,295kg)
Launch Abort System Jettison	256.5s @ 56.9nmi

BOOSTERS (each)

Design Heritage	Shuttle-derived 5-segment RSRMV
Propellants	PBAN
Usable Propellant	1,380,873lb (626,353kg)
Stage pmf	0.8656
Dry Mass	228,620lb (103,700kg)
Burnout Mass	232,608lb (105,509kg)
# Boosters / Type	2 / 5-segment RSRMV
Booster Thrust (@ 0.7s) SL	3,510,791lbf (1,592,468kgf / 15,616,776N)
Vac	3,510,791lbf (1,592,468kgf / 15,616,776N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	267.4s
Booster Burn Time	126.6s

CORE STAGE

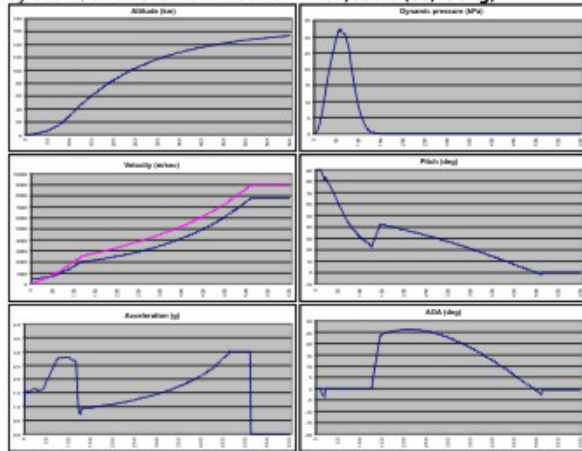
Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9107
Dry Mass	140,489lb (63,725kg)
Burnout Mass	156,536lb (71,004kg)
# Engines / Type	3 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	512.1s



DYNAMICS	Blackzone Safe Trajectory
Thrust : Weight @ Liftoff	1.513 : 1
Max Dynamic Pressure	674.6psf (32,301Pa)
Max g's During Ascent	3.00g
Insertion Altitude	79.9nmi (147.9km)

ASCENT PERFORMANCE

Delivery Orbit	30.0 x 100.0nmi, 29.0°
Payload w/ regular NASA GR&A's	208,700lb (94,665kg)
Payload w/ additional 10% Reserve	187,830lb (85,198kg)



Work In Progress
8th June 2009

* ASE is part of the Payload, not additional

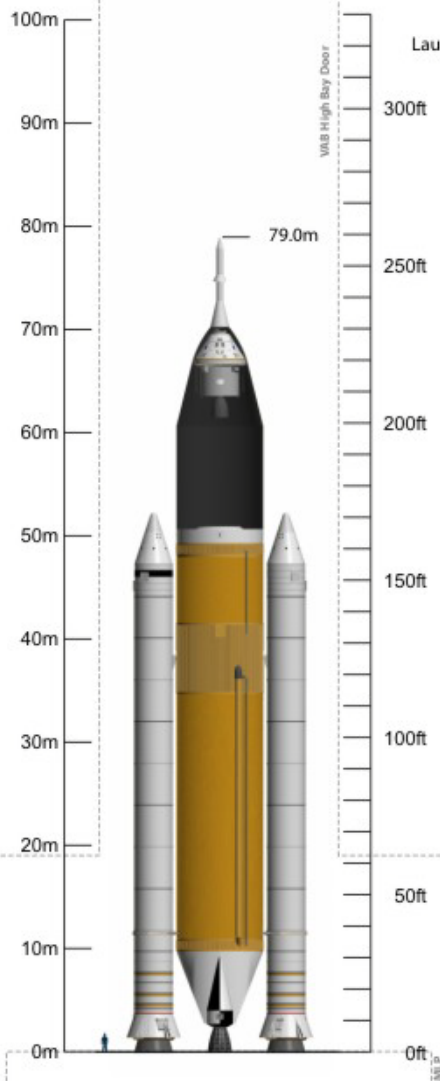
Vehicle Concept Characteristics - LV 41.5000.08100

Launch Site KSC LC-39 (Latitude: 28.6084°)

GLOW 5,480,315lb (2,485,829kg)
 Payload Fairing 27.6 x 32.8ft (8.4 x 10.0m)
 Payload Envelope 25.0 x 32.8ft (7.6 x 10.0m)
 Payload Fairing Jettison Mass 12,365lb (5,609kg)
 Payload Fairing Jettison After Orbital Insertion
 Launch Abort System Jettison Mass 16,083lb (7,295kg)
 Launch Abort System Jettison 257.0s @ 55.6nmi

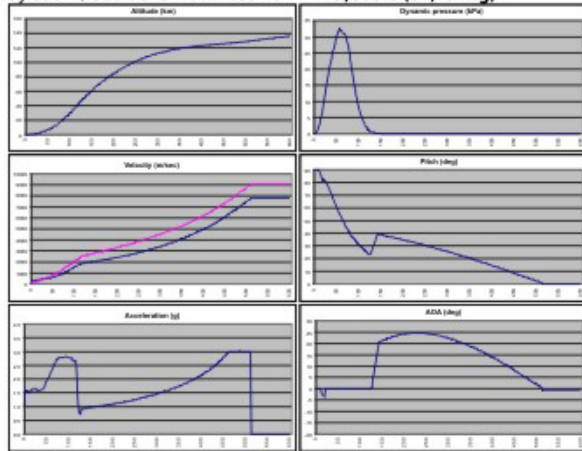
BOOSTERS (each)
 Design Heritage Shuttle-derived 5-segment RSRMV
 Propellants PBAN
 Usable Propellant 1,380,873lb (626,353kg)
 Stage pmf 0.8656
 Dry Mass 228,620lb (103,700kg)
 Burnout Mass 232,608lb (105,509kg)
 # Boosters / Type 2 / 5-segment RSRMV
 Booster Thrust (@ 0.7s) SL 3,510,791lbf (1,592,468kgf / 15,616,776N)
 Vac 3,510,791lbf (1,592,468kgf / 15,616,776N)
 Booster Isp (@ 0.7s) SL 237.0s
 Vac 267.4s
 Booster Burn Time 126.6s

CORE STAGE
 Design Heritage Shuttle Super Light Weight Tank ET
 Propellants LOX / LH2
 Gross Propellant 1,621,191lb (735,360kg)
 Usable Ascent Propellant 1,604,979lb (728,006kg)
 Unusable Residuals 16,047lb (7,279kg)
 In-Flight Losses 325lb (147kg)
 Propellant Offload 0.00%
 Stage pmf 0.9107
 Dry Mass 140,489lb (63,725kg)
 Burnout Mass 156,536lb (71,004kg)
 # Engines / Type 3 / SSME-Block-II
 Engine Thrust (@ 104.5%) SL 392,326lbf (177,956kgf / 1,745,155N)
 Vac 490,847lbf (222,644kgf / 2,183,396N)
 Engine Isp (@ 104.5%) SL 361.4s
 Vac 452.2s
 Mission Power Level 104.5%
 Core Burn Time 513.1s



DYNAMICS
 Thrust : Weight @ Liftoff 1.515 : 1
 Max Dynamic Pressure 675.4psf (32,338Pa)
 Max g's During Ascent 3.00g
 Insertion Altitude 70.0nmi (129.6km)

ASCENT PERFORMANCE
 Delivery Orbit 30.0 x 100.0nmi, 51.6°
 Payload w/ regular NASA GR&A's 199,626lb (90,549kg)
 Payload w/ additional 10% Reserve 179,663lb (81,494kg)



Work In Progress
 8th June 2009

* ASE is part of the Payload, not additional

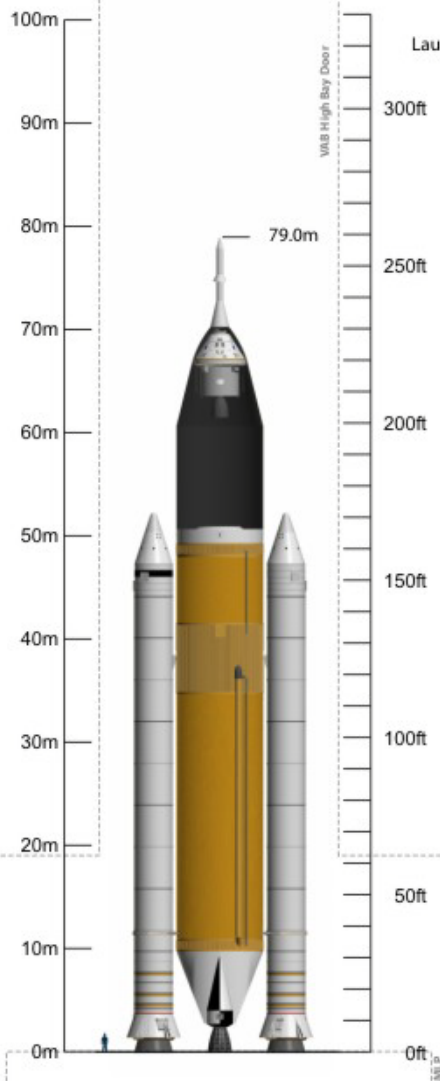
Vehicle Concept Characteristics - LV 41.5000.08100

Launch Site KSC LC-39 (Latitude: 28.6084°)

GLOW 5,477,330lb (2,484,475kg)
 Payload Fairing 27.6 x 32.8ft (8.4 x 10.0m)
 Payload Envelope 25.0 x 32.8ft (7.6 x 10.0m)
 Payload Fairing Jettison Mass 12,365lb (5,609kg)
 Payload Fairing Jettison After Orbital Insertion
 Launch Abort System Jettison Mass 16,083lb (7,295kg)
 Launch Abort System Jettison 257.5s @ 61.8nmi

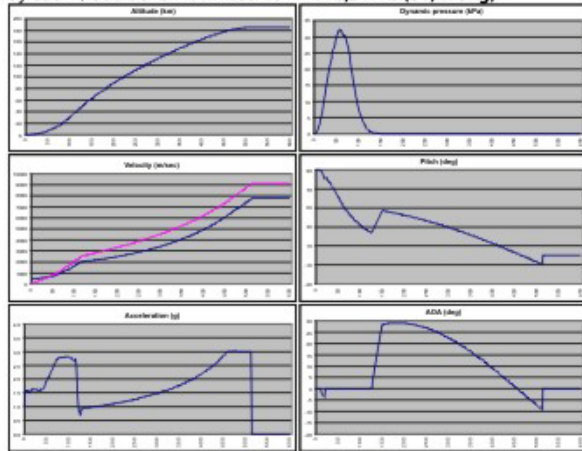
BOOSTERS (each)
 Design Heritage Shuttle-derived 5-segment RSRMV
 Propellants PBAN
 Usable Propellant 1,380,873lb (626,353kg)
 Stage pmf 0.8656
 Dry Mass 228,620lb (103,700kg)
 Burnout Mass 232,608lb (105,509kg)
 # Boosters / Type 2 / 5-segment RSRMV
 Booster Thrust (@ 0.7s) SL 3,510,791lbf (1,592,468kgf / 15,616,776N)
 Vac 3,510,791lbf (1,592,468kgf / 15,616,776N)
 Booster Isp (@ 0.7s) SL 237.0s
 Vac 267.4s
 Booster Burn Time 126.6s

CORE STAGE
 Design Heritage Shuttle Super Light Weight Tank ET
 Propellants LOX / LH2
 Gross Propellant 1,621,191lb (735,360kg)
 Usable Ascent Propellant 1,604,979lb (728,006kg)
 Unusable Residuals 16,047lb (7,279kg)
 In-Flight Losses 325lb (147kg)
 Propellant Offload 0.00%
 Stage pmf 0.9107
 Dry Mass 140,489lb (63,725kg)
 Burnout Mass 156,536lb (71,004kg)
 # Engines / Type 3 / SSME-Block-II
 Engine Thrust (@ 104.5%) SL 392,326lbf (177,956kgf / 1,745,155N)
 Vac 490,847lbf (222,644kgf / 2,183,396N)
 Engine Isp (@ 104.5%) SL 361.4s
 Vac 452.2s
 Mission Power Level 104.5%
 Core Burn Time 514.1s



DYNAMICS
 Thrust : Weight @ Liftoff 1.516 : 1
 Max Dynamic Pressure 671.6psf (32,155Pa)
 Max g's During Ascent 3.00g
 Insertion Altitude 100.0nmi (185.2km)

ASCENT PERFORMANCE
 Delivery Orbit 100.0 x 100.0nmi, 29.0°
 Payload w/ regular NASA GR&A's 196,641lb (89,195kg)
 Payload w/ additional 10% Reserve 176,977lb (80,275kg)



Work In Progress
 8th June 2009

* ASE is part of the Payload, not additional

Vehicle Concept Characteristics - LV 41.5000.08100

Launch Site KSC LC-39 (Latitude: 28.6084°)

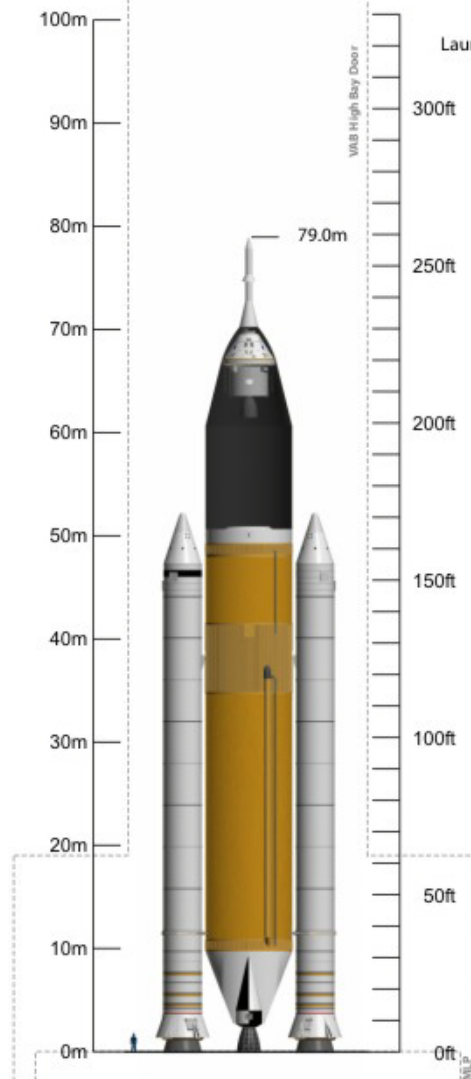
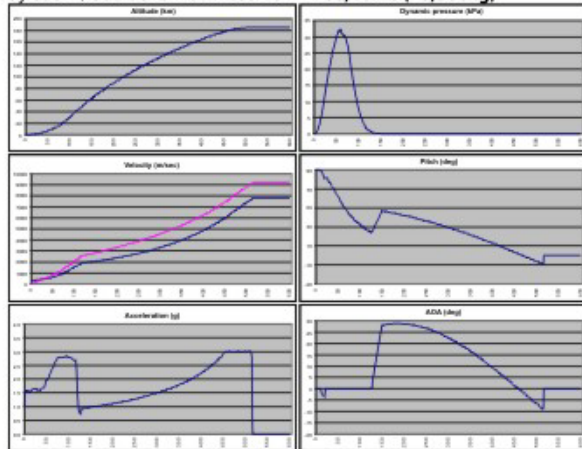
GLOW	5,465,647lb (2,479,176kg)
Payload Fairing	27.6 x 32.8ft (8.4 x 10.0m)
Payload Envelope	25.0 x 32.8ft (7.6 x 10.0m)
Payload Fairing Jettison Mass	12,365lb (5,609kg)
Payload Fairing Jettison	After Orbital Insertion
Launch Abort System Jettison Mass	16,083lb (7,295kg)
Launch Abort System Jettison	258.5s @ 62.3nmi

BOOSTERS (each)	
Design Heritage	Shuttle-derived 5-segment RSRMV
Propellants	PBAN
Usable Propellant	1,380,873lb (626,353kg)
Stage pmf	0.8656
Dry Mass	228,620lb (103,700kg)
Burnout Mass	232,608lb (105,509kg)
# Boosters / Type	2 / 5-segment RSRMV
Booster Thrust (@ 0.7s) SL	3,510,791lbf (1,592,468kgf / 15,616,776N)
Vac	3,510,791lbf (1,592,468kgf / 15,616,776N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	267.4s
Booster Burn Time	126.6s

CORE STAGE	
Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9107
Dry Mass	140,489lb (63,725kg)
Burnout Mass	156,536lb (71,004kg)
# Engines / Type	3 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	516.1s

DYNAMICS	Blackzone Safe Trajectory
Thrust : Weight @ Liftoff	1.519 : 1
Max Dynamic Pressure	671.7psf (32,159Pa)
Max g's During Ascent	3.00g
Insertion Altitude	100.0nmi (185.2km)

ASCENT PERFORMANCE	
Delivery Orbit	100.0 x 100.0nmi, 51.6°
Payload w/ regular NASA GR&A's	184,958lb (83,896kg)
Payload w/ additional 10% Reserve	166,462lb (75,506kg)

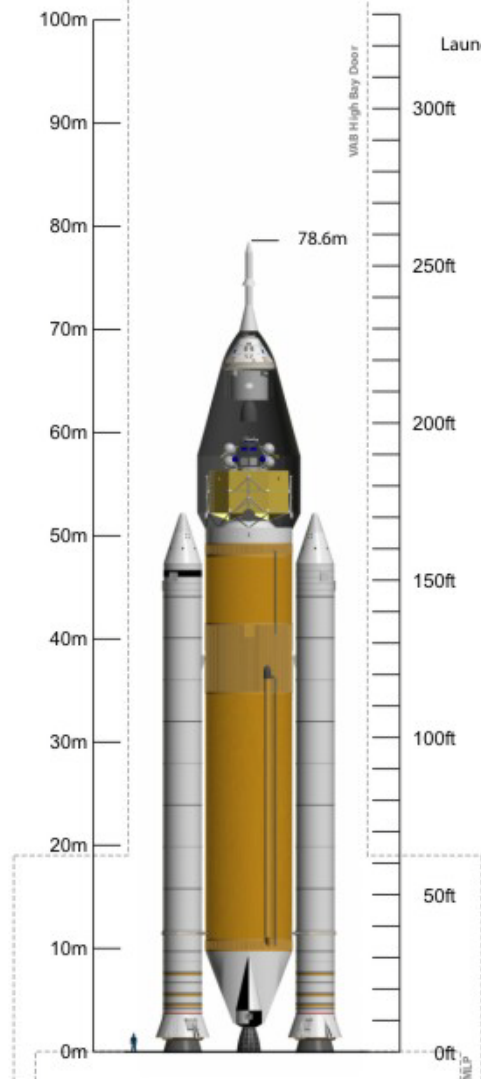
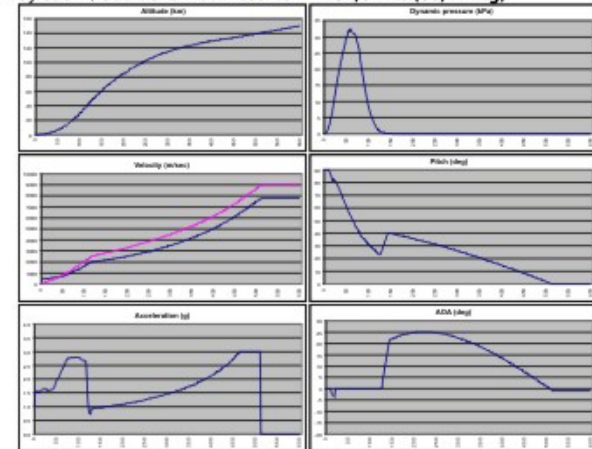


Work In Progress
8th June 2009

* ASE is part of the Payload, not additional

Vehicle Concept Characteristics - LV 41.5000.10050

DYNAMICS	Blackzone Safe Trajectory
Thrust : Weight @ Liftoff	1.513 : 1
Max Dynamic Pressure	674.6psf (32,301Pa)
Max g's During Ascent	3.00g
Insertion Altitude	75.8nmi (140.5km)
ASCENT PERFORMANCE	
Delivery Orbit	30.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	208,494lb (94,571kg)
Payload w/ additional 10% Reserve	187,644lb (85,114kg)



Launch Site KSC LC-39 (Latitude: 28.6084°)

GLOW	5,489,389lb (2,489,945kg)
Payload Fairing	32.8 x 18.4ft (10.0 x 5.6m)
Payload Envelope	30.2 x 18.4ft (9.2 x 5.6m)
Payload Fairing Jettison Mass	12,571lb (5,702kg)
Payload Fairing Jettison	After Orbital Insertion
Launch Abort System Jettison Mass	16,083lb (7,295kg)
Launch Abort System Jettison	256.5s @ 56.1nmi
BOOSTERS (each)	
Design Heritage	Shuttle-derived 5-segment RSRMV
Propellants	PBAN
Usable Propellant	1,380,873lb (626,353kg)
Stage pmf	0.8656
Dry Mass	228,620lb (103,700kg)
Burnout Mass	232,608lb (105,509kg)
# Boosters / Type	2 / 5-segment RSRMV
Booster Thrust (@ 0.7s) SL	3,510,791lbf (1,592,468kgf / 15,616,776N)
Vac	3,510,791lbf (1,592,468kgf / 15,616,776N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	267.4s
Booster Burn Time	126.6s
CORE STAGE	
Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9107
Dry Mass	140,489lb (63,725kg)
Burnout Mass	156,536lb (71,004kg)
# Engines / Type	3 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	512.1s

Work In Progress
8th June 2009

* ASE is part of the Payload, not additional

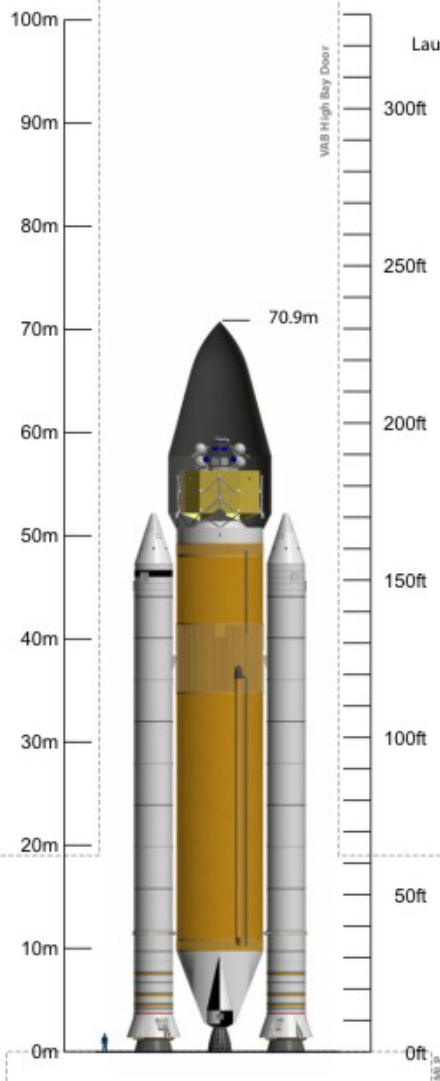
Vehicle Concept Characteristics - LV 41.5000.10051

Launch Site KSC LC-39 (Latitude: 28.6084°)

GLOW	5,477,850lb (2,484,711kg)
Payload Fairing	32.8 x 18.4ft (10.0 x 5.6m)
Payload Envelope	30.2 x 18.4ft (9.2 x 5.6m)
Payload Fairing Jettison Mass	15,916lb (7,219kg)
Payload Fairing Jettison	601.7s @ 75.6nmi
Launch Abort System Jettison Mass	-
Launch Abort System Jettison	-

BOOSTERS (each)	
Design Heritage	Shuttle-derived 5-segment RSRMV
Propellants	PBAN
Usable Propellant	1,380,873lb (626,353kg)
Stage pmf	0.8656
Dry Mass	228,620lb (103,700kg)
Burnout Mass	232,608lb (105,509kg)
# Boosters / Type	2 / 5-segment RSRMV
Booster Thrust (@ 0.7s) SL	3,510,791lbf (1,592,468kgf / 15,616,776N)
Vac	3,510,791lbf (1,592,468kgf / 15,616,776N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	267.4s
Booster Burn Time	126.6s

CORE STAGE	
Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9107
Dry Mass	140,489lb (63,725kg)
Burnout Mass	156,536lb (71,004kg)
# Engines / Type	3 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	512.1s

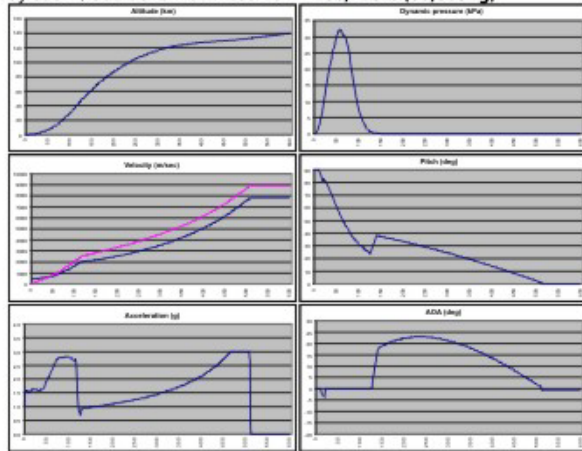


DYNAMICS

Thrust : Weight @ Liftoff	1.516 : 1
Max Dynamic Pressure	671.7psf (32,162Pa)
Max g's During Ascent	3.00g
Insertion Altitude	71.9nmi (133.2km)

ASCENT PERFORMANCE

Delivery Orbit	51.5 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	209,692lb (95,115kg)
Payload w/ additional 10% Reserve	188,723lb (85,603kg)



Work In Progress

8th June 2009

* ASE is part of the Payload, not additional



DIRECT - Phase 2

Exploration Operations

Launch Vehicle Option A

Jupiter-241
(J-2X)

Vehicle Concept Characteristics - LV 41.4002.08001

UPPER STAGE

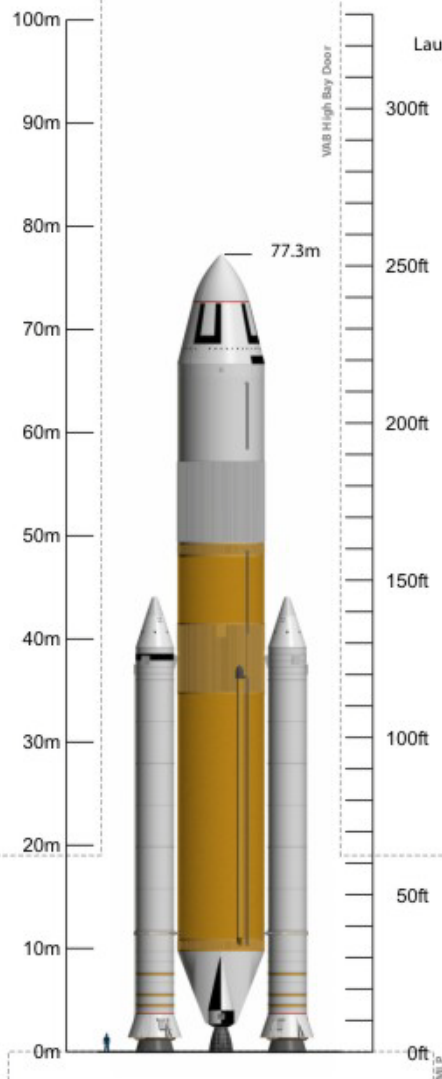
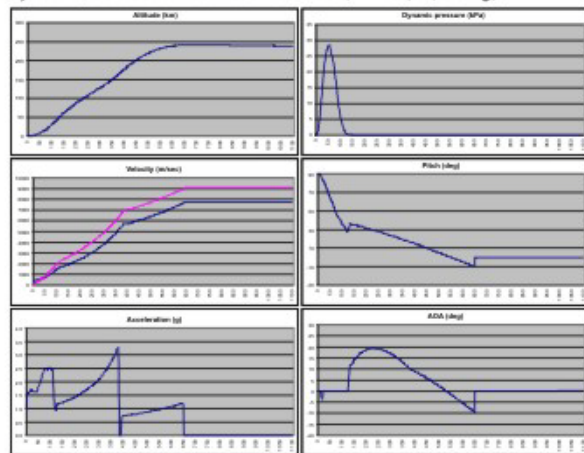
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	400,519lb (181,672kg)
Usable Ascent Propellant	159,634lb (72,409kg)
Ascent Flight Performance Reserve	6,677lb (3,029kg)
Usable Post-Ascent Propellant	227,955lb (103,399kg)
Post-Ascent Flight Performance Reserve	2,303lb (1,044kg)
Unusable Residuals	3,911lb (1,774kg)
Ascent In-Flight Losses	39lb (18kg)
RCS Propellant	992lb (450kg)
Propellant Offload	0.00%
Stage pmf	0.9282
Dry Mass	26,785lb (12,150kg)
Burnout Mass	30,696lb (13,924kg)
# Engines / Type	1 / J-2X
Engine Thrust (@ 100%) Vac	294,000lbf (133,356kgf / 1,307,777N)
Engine Isp (@ 100%) Vac	448.0s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	261.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	6,677lb (3,029kg)
ASE*	1,102lb (500kg)

DYNAMICS

Thrust : Weight @ Liftoff	1.527 : 1
Max Dynamic Pressure	598.9psf (28,676Pa)
Max g's During Ascent	3.31g
Insertion Altitude	130.0nmi (240.8km)

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	232,352lb (105,393kg)
Payload w/ additional 10% Reserve	209,117lb (94,854kg)



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW

Payload Fairing	4,817,530lb (2,185,195kg)
Payload Envelope	27.6 x 0.0ft (8.4 x 0.0m)
Payload Fairing Jettison Mass	25.0 x 0.0ft (7.6 x 0.0m)
Payload Fairing Jettison	8,724lb (3,957kg)
Launch Abort System Jettison Mass	306.7s @ 70.4nmi
Launch Abort System Jettison	-

BOOSTERS (each)

Design Heritage	Shuttle RSRM - Flown Unchanged
Propellants	PBAN
Usable Propellant	1,111,604lb (504,215kg)
Stage pmf	0.8561
Dry Mass	183,948lb (83,437kg)
Burnout Mass	186,864lb (84,760kg)
# Boosters / Type	2 / 4-segment Shuttle RSRM
Booster Thrust (@ 0.7s) SL	2,892,912lbf (1,312,203kgf / 12,868,314N)
Vac	3,142,302lbf (1,425,324kgf / 13,977,656N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	269.1s
Booster Burn Time	123.8s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	11,664lb (5,291kg)
----------	--------------------

EDS TLI PERFORMANCE

2-Launch EOR	3,175.0m/s (+ FPR)
TLI dV (Adj. for Gravity Losses)	5.0 days
LEO Loiter Period	TLI Payload Performance*
TLI Payload Performance*	175,772lb (79,729kg)

Work In Progress

6th June 2009

* ASE is part of the Payload, not additional

Vehicle Concept Characteristics - LV 41.4002.10050

UPPER STAGE

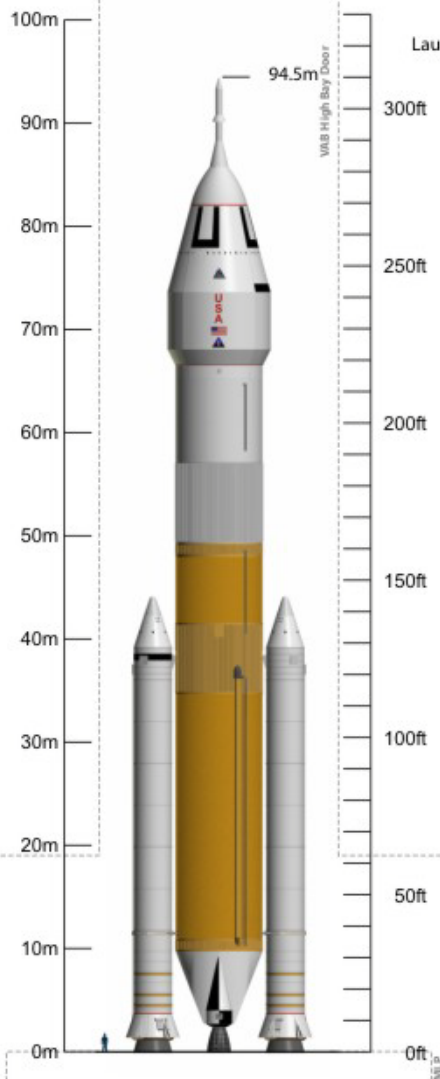
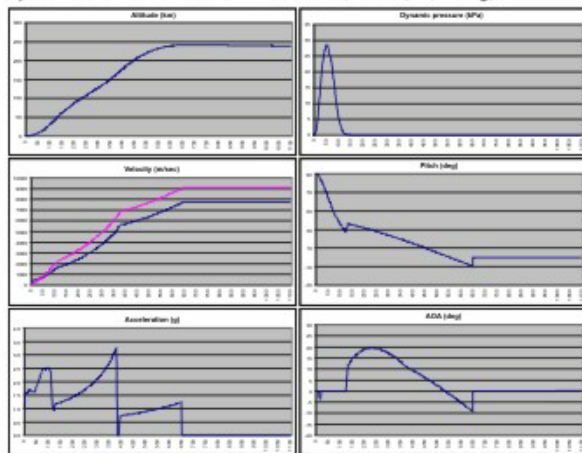
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	400,519lb (181,672kg)
Usable Ascent Propellant	159,634lb (72,409kg)
Ascent Flight Performance Reserve	6,677lb (3,029kg)
Usable Post-Ascent Propellant	-
Post-Ascent Flight Performance Reserve	-
Unusable Residuals	3,911lb (1,774kg)
Ascent In-Flight Losses	39lb (18kg)
RCS Propellant	992lb (450kg)
Propellant Offload	56.91%
Stage pmf	0.9282
Dry Mass	26,785lb (12,150kg)
Burnout Mass	30,696lb (13,924kg)
# Engines / Type	1 / J-2X
Engine Thrust (@ 100%) Vac	294,000lbf (133,356kgf / 1,307,777N)
Engine Isp (@ 100%) Vac	448.0s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	261.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	-
ASE*	3,064lb (1,390kg)

DYNAMICS

Blackzone Safe Trajectory	1.526 : 1
Thrust : Weight @ Liftoff	598.9psf (28,676Pa)
Max Dynamic Pressure	3.25g
Max g's During Ascent	130.0nmi (240.8km)
Insertion Altitude	

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	214,054lb (97,093kg)
Payload w/ additional 10% Reserve	192,649lb (87,384kg)



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW

Payload Fairing	4,819,162lb (2,185,935kg)
Payload Envelope	32.8 x 18.4ft (10.0 x 5.6m)
Payload Fairing Jettison Mass	30.2 x 18.4ft (9.2 x 5.6m)
Payload Fairing Jettison	12,571lb (5,702kg)
Launch Abort System Jettison	After Orbital Insertion
Launch Abort System Jettison	16,083lb (7,295kg)
Launch Abort System Jettison	405.0s @ 97.1nmi

BOOSTERS (each)

Design Heritage	Shuttle RSRM - Flown Unchanged
Propellants	PBAN
Usable Propellant	1,111,604lb (504,215kg)
Stage pmf	0.8561
Dry Mass	183,948lb (83,437kg)
Burnout Mass	186,864lb (84,760kg)
# Boosters / Type	2 / 4-segment Shuttle RSRM
Booster Thrust (@ 0.7s) SL	2,892,912lbf (1,312,203kgf / 12,868,314N)
Vac	3,142,302lbf (1,425,324kgf / 13,977,656N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	269.1s
Booster Burn Time	123.8s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	11,664lb (5,291kg)
----------	--------------------

Work In Progress

6th June 2009

* ASE is part of the Payload, not additional

Vehicle Concept Characteristics - LV 41.4002.10051

UPPER STAGE

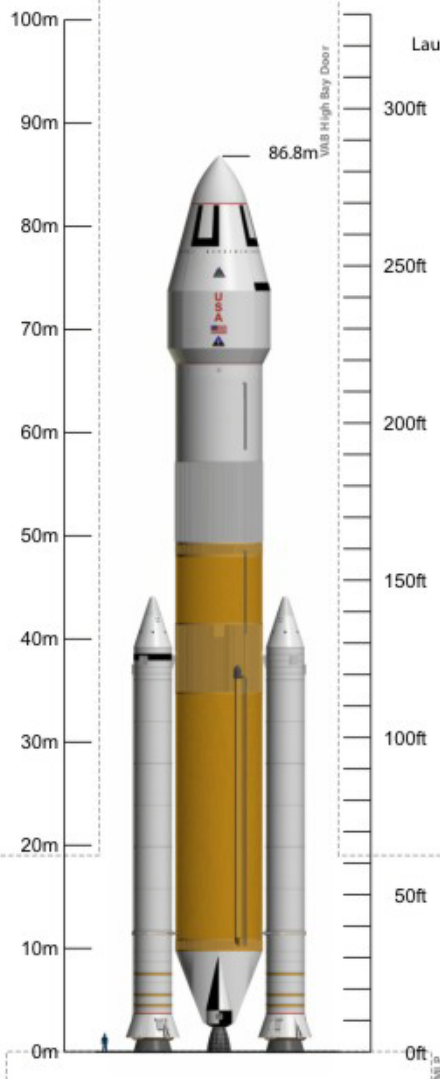
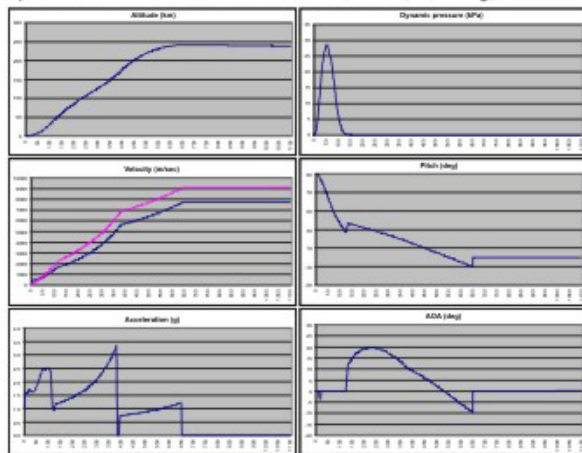
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	400,519lb (181,672kg)
Usable Ascent Propellant	159,634lb (72,409kg)
Ascent Flight Performance Reserve	6,677lb (3,029kg)
Usable Post-Ascent Propellant	-
Post-Ascent Flight Performance Reserve	-
Unusable Residuals	3,911lb (1,774kg)
Ascent In-Flight Losses	39lb (18kg)
RCS Propellant	992lb (450kg)
Propellant Offload	56.91%
Stage pmf	0.9282
Dry Mass	26,785lb (12,150kg)
Burnout Mass	30,696lb (13,924kg)
# Engines / Type	1 / J-2X
Engine Thrust (@ 100%) Vac	294,000lbf (133,356kgf / 1,307,777N)
Engine Isp (@ 100%) Vac	448.0s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	261.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	6,677lb (3,029kg)
ASE*	1,102lb (500kg)

DYNAMICS

Thrust : Weight @ Liftoff	1.525 : 1
Max Dynamic Pressure	598.9psf (28,675Pa)
Max g's During Ascent	3.32g
Insertion Altitude	130.0nmi (240.8km)

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	230,266lb (104,447kg)
Payload w/ additional 10% Reserve	207,239lb (94,002kg)



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW

Payload Fairing	4,822,636lb (2,187,511kg)
Payload Envelope	32.8 x 18.4ft (10.0 x 5.6m)
Payload Fairing Jettison Mass	30.2 x 18.4ft (9.2 x 5.6m)
Payload Fairing Jettison	15,916lb (7,219kg)
Launch Abort System Jettison Mass	306.6s @ 70.5nmi
Launch Abort System Jettison	-

BOOSTERS (each)

Design Heritage	Shuttle RSRM - Flown Unchanged
Propellants	PBAN
Usable Propellant	1,111,604lb (504,215kg)
Stage pmf	0.8561
Dry Mass	183,948lb (83,437kg)
Burnout Mass	186,864lb (84,760kg)
# Boosters / Type	2 / 4-segment Shuttle RSRM
Booster Thrust (@ 0.7s) SL	2,892,912lbf (1,312,203kgf / 12,868,314N)
Vac	3,142,302lbf (1,425,324kgf / 13,977,656N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	269.1s
Booster Burn Time	123.8s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	11,664lb (5,291kg)
----------	--------------------

Work In Progress

6th June 2009

* ASE is part of the Payload, not additional



DIRECT - Phase 2

Exploration Operations

Launch Vehicle Option B

Jupiter-244
(RL-60)

Vehicle Concept Characteristics - LV 41.4005.08001

UPPER STAGE

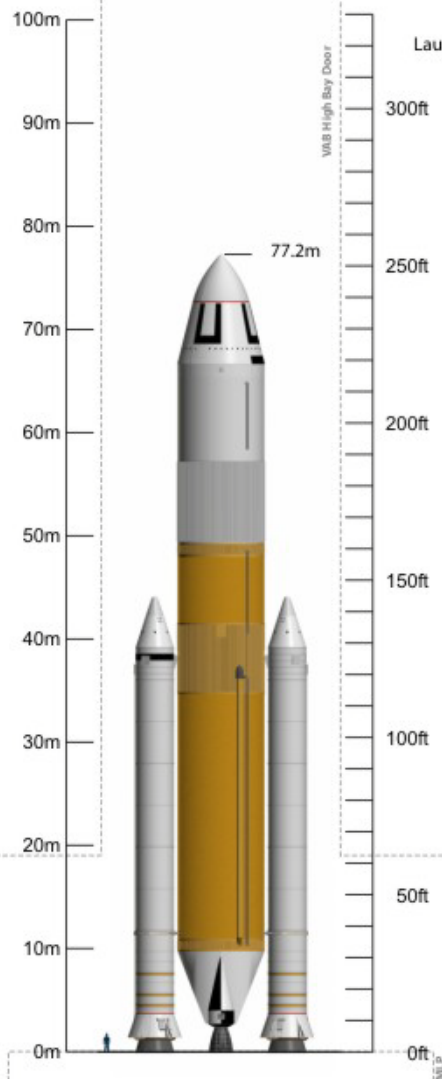
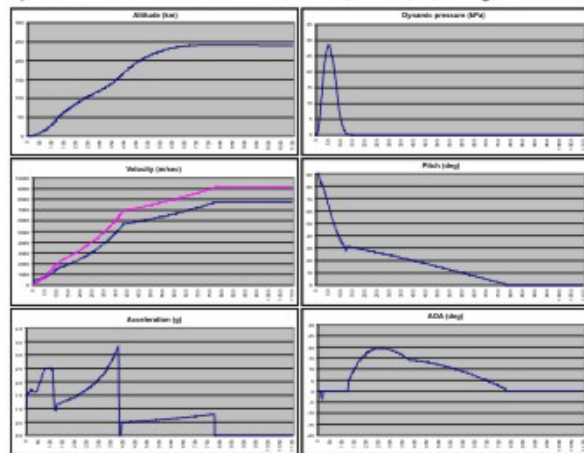
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	397,261lb (180,195kg)
Usable Ascent Propellant	154,920lb (70,271kg)
Ascent Flight Performance Reserve	6,493lb (2,945kg)
Usable Post-Ascent Propellant	229,492lb (104,096kg)
Post-Ascent Flight Performance Reserve	2,318lb (1,051kg)
Unusable Residuals	3,884lb (1,762kg)
Ascent In-Flight Losses	154lb (70kg)
RCS Propellant	992lb (450kg)
Propellant Offload	0.00%
Stage pmf	0.9303
Dry Mass	25,605lb (11,614kg)
Burnout Mass	29,489lb (13,376kg)
# Engines / Type	4 / RL-60
Engine Thrust (@ 100%) Vac	64,992lbf (29,480kgf / 289,100N)
Engine Isp (@ 100%) Vac	459.0s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	390.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	6,493lb (2,945kg)
ASE*	1,102lb (500kg)

DYNAMICS

Thrust : Weight @ Liftoff	1.528 : 1
Max Dynamic Pressure	598.9psf (28,677Pa)
Max g's During Ascent	3.32g
Insertion Altitude	130.0nmi (240.8km)

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	233,905lb (106,097kg) †
Payload w/ additional 10% Reserve	210,514lb (95,488kg) †



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW

Payload Fairing	4,813,107lb (2,183,189kg)
Payload Envelope	27.6 x 0.0ft (8.4 x 0.0m)
Payload Fairing Jettison Mass	25.0 x 0.0ft (7.6 x 0.0m)
Payload Fairing Jettison	8,724lb (3,957kg)
Launch Abort System Jettison Mass	333.3s @ 71.9nmi
Launch Abort System Jettison	-

BOOSTERS (each)

Design Heritage	Shuttle RSRM - Flown Unchanged
Propellants	PBAN
Usable Propellant	1,111,604lb (504,215kg)
Stage pmf	0.8561
Dry Mass	183,948lb (83,437kg)
Burnout Mass	186,864lb (84,760kg)
# Boosters / Type	2 / 4-segment Shuttle RSRM
Booster Thrust (@ 0.7s) SL	2,892,912lbf (1,312,203kgf / 12,868,314N)
Vac	3,142,302lbf (1,425,324kgf / 13,977,656N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	269.1s
Booster Burn Time	123.8s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	11,664lb (5,291kg)
----------	--------------------

EDS TLI PERFORMANCE

2-Launch EOR	
TLI dV (Adj. for Gravity Losses)	3,205.0m/s (+ FPR)
LEO Loiter Period	5.0 days
TLI Payload Performance*	182,970lb (82,994kg) ‡

Work In Progress

6th June 2009

* ASE is part of the Payload, not additional

† Ascent Performance for Jupiter-244 protects for Upper Stage Single-Engine-Out and full FPR

‡ TLI Performance for Jupiter-244 protects for Upper Stage Dual-Engine-Out and full FPR

Vehicle Concept Characteristics - LV 41.4005.10050

UPPER STAGE

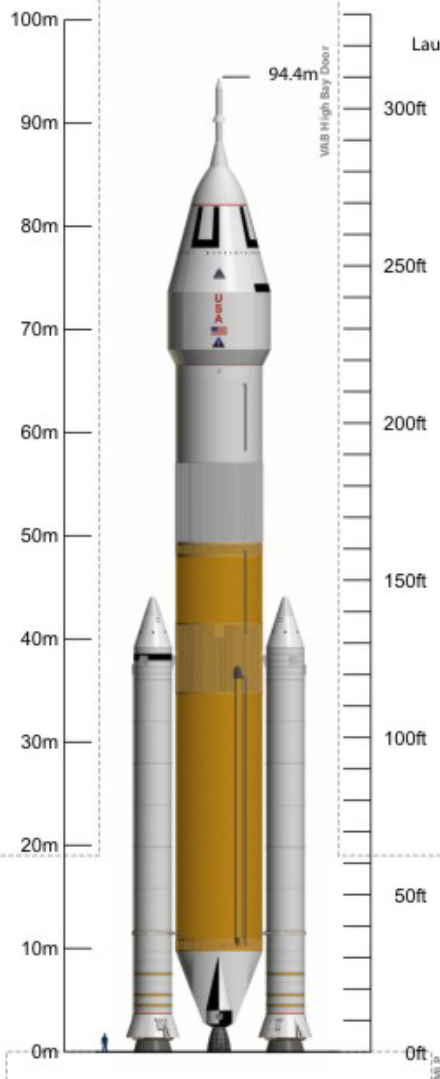
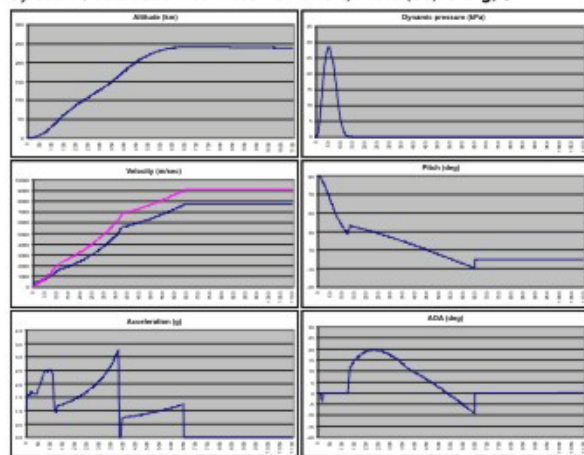
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	397,261lb (180,195kg)
Usable Ascent Propellant	154,920lb (70,271kg)
Ascent Flight Performance Reserve	6,493lb (2,945kg)
Usable Post-Ascent Propellant	-
Post-Ascent Flight Performance Reserve	-
Unusable Residuals	3,884lb (1,762kg)
Ascent In-Flight Losses	154lb (70kg)
RCS Propellant	992lb (450kg)
Propellant Offload	57.77%
Stage pmf	0.9303
Dry Mass	25,605lb (11,614kg)
Burnout Mass	29,489lb (13,376kg)
# Engines / Type	4 / RL-60
Engine Thrust (@ 100%) Vac	64,992lbf (29,480kgf / 289,100N)
Engine Isp (@ 100%) Vac	459.0s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	390.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	-
ASE*	3,064lb (1,390kg)

DYNAMICS

Blackzone Safe Trajectory	1.528 : 1
Thrust : Weight @ Liftoff	598.9psf (28,677Pa)
Max Dynamic Pressure	3.27g
Max g's During Ascent	130.0nmi (240.8km)
Insertion Altitude	

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	216,045lb (97,996kg) †
Payload w/ additional 10% Reserve	194,440lb (88,197kg) †



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW

Payload Fairing	4,815,177lb (2,184,127kg)
Payload Envelope	32.8 x 18.4ft (10.0 x 5.6m)
Payload Fairing Jettison Mass	30.2 x 18.4ft (9.2 x 5.6m)
Payload Fairing Jettison	12,571lb (5,702kg)
Launch Abort System Jettison	After Orbital Insertion
Launch Abort System Jettison	16,083lb (7,295kg)
Launch Abort System Jettison	405.0s @ 92.3nmi

BOOSTERS (each)

Design Heritage	Shuttle RSRM - Flown Unchanged
Propellants	PBAN
Usable Propellant	1,111,604lb (504,215kg)
Stage pmf	0.8561
Dry Mass	183,948lb (83,437kg)
Burnout Mass	186,864lb (84,760kg)
# Boosters / Type	2 / 4-segment Shuttle RSRM
Booster Thrust (@ 0.7s) SL	2,892,912lbf (1,312,203kgf / 12,868,314N)
Vac	3,142,302lbf (1,425,324kgf / 13,977,656N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	269.1s
Booster Burn Time	123.8s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	11,664lb (5,291kg)
----------	--------------------

Work In Progress

6th June 2009

* ASE is part of the Payload, not additional

† Ascent Performance for Jupiter-244 protects for Upper Stage Single-Engine-Out and full FPR

Vehicle Concept Characteristics - LV 41.4005.10051

UPPER STAGE

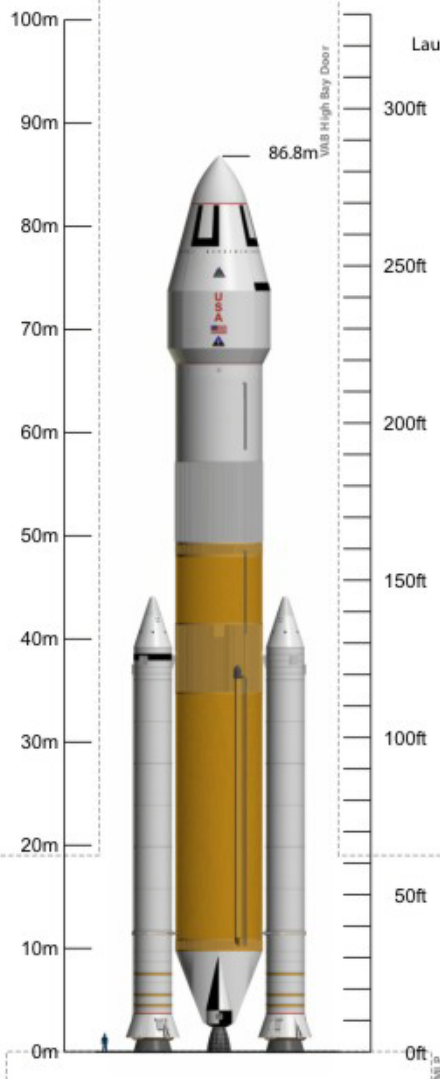
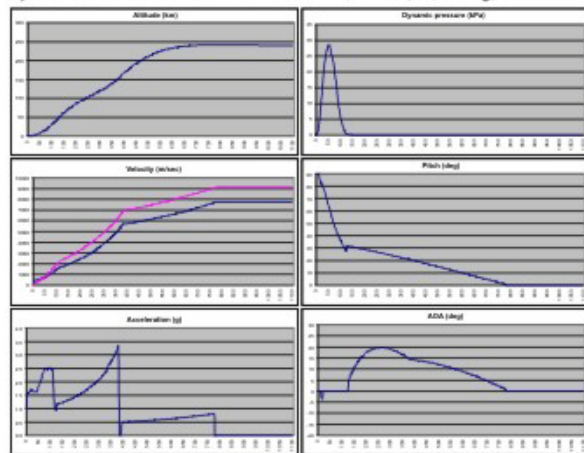
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	397,261lb (180,195kg)
Usable Ascent Propellant	154,920lb (70,271kg)
Ascent Flight Performance Reserve	6,493lb (2,945kg)
Usable Post-Ascent Propellant	-
Post-Ascent Flight Performance Reserve	-
Unusable Residuals	3,884lb (1,762kg)
Ascent In-Flight Losses	154lb (70kg)
RCS Propellant	992lb (450kg)
Propellant Offload	57.77%
Stage pmf	0.9303
Dry Mass	25,605lb (11,614kg)
Burnout Mass	29,489lb (13,376kg)
# Engines / Type	4 / RL-60
Engine Thrust (@ 100%) Vac	64,992lbf (29,480kgf / 289,100N)
Engine Isp (@ 100%) Vac	459.0s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	390.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	-
ASE*	1,102lb (500kg)

DYNAMICS

Thrust : Weight @ Liftoff	1.527 : 1
Max Dynamic Pressure	598.9psf (28,676Pa)
Max g's During Ascent	3.33g
Insertion Altitude	130.0nmi (240.8km)

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	231,469lb (104,993kg) †
Payload w/ additional 10% Reserve	208,322lb (94,493kg) †



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW

Payload Fairing	4,817,864lb (2,185,346kg)
Payload Envelope	32.8 x 18.4ft (10.0 x 5.6m)
Payload Fairing Jettison Mass	30.2 x 18.4ft (9.2 x 5.6m)
Payload Fairing Jettison	15,916lb (7,219kg)
Launch Abort System Jettison Mass	333.7s @ 72.1nmi
Launch Abort System Jettison	-

BOOSTERS (each)

Design Heritage	Shuttle RSRM - Flown Unchanged
Propellants	PBAN
Usable Propellant	1,111,604lb (504,215kg)
Stage pmf	0.8561
Dry Mass	183,948lb (83,437kg)
Burnout Mass	186,864lb (84,760kg)
# Boosters / Type	2 / 4-segment Shuttle RSRM
Booster Thrust (@ 0.7s) SL	2,892,912lbf (1,312,203kgf / 12,868,314N)
Vac	3,142,302lbf (1,425,324kgf / 13,977,656N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	269.1s
Booster Burn Time	123.8s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	11,664lb (5,291kg)
----------	--------------------

Work In Progress

6th June 2009

* ASE is part of the Payload, not additional

† Ascent Performance for Jupiter-244 protects for Upper Stage Single-Engine-Out and full FPR



DIRECT - Phase 2

Exploration Operations

Launch Vehicle Option C

Jupiter-246
(RL-10A-4-2)

Vehicle Concept Characteristics - LV 41.4003.08001

UPPER STAGE

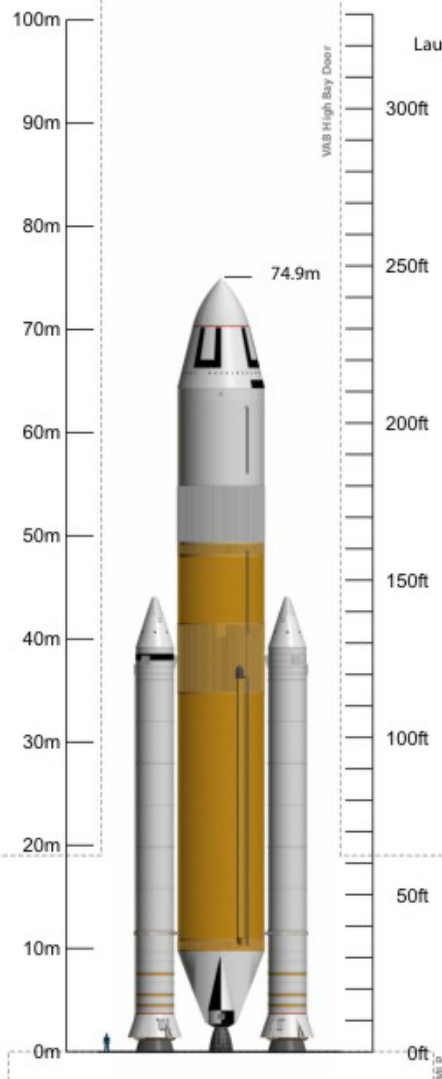
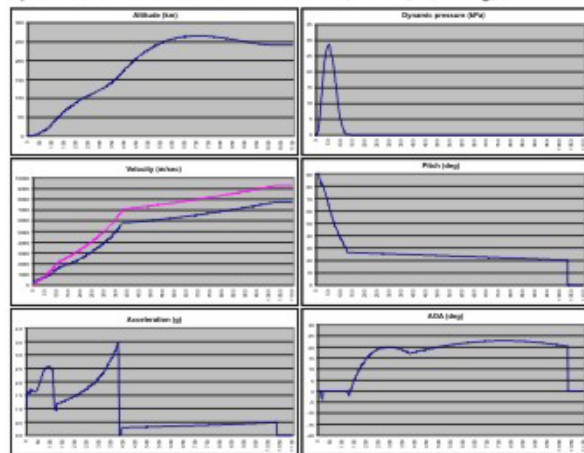
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	379,321lb (172,057kg)
Usable Ascent Propellant	151,961lb (68,928kg)
Ascent Flight Performance Reserve	6,418lb (2,911kg)
Usable Post-Ascent Propellant	214,816lb (97,439kg)
Post-Ascent Flight Performance Reserve	2,170lb (984kg)
Unusable Residuals	3,735lb (1,694kg)
Ascent In-Flight Losses	220lb (100kg)
RCS Propellant	992lb (450kg)
Propellant Offload	0.00%
Stage pmf	0.9342
Dry Mass	22,737lb (10,313kg)
Burnout Mass	26,473lb (12,008kg)
# Engines / Type	6 / RL-10A-4-2
Engine Thrust (@ 100%) Vac	22,300lbf (10,115kgf / 99,195N)
Engine Isp (@ 100%) Vac	445.2s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	646.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	6,418lb (2,911kg)
ASE*	1,102lb (500kg)

DYNAMICS

Thrust : Weight @ Liftoff	1.536 : 1
Max Dynamic Pressure	599.0psf (28,678Pa)
Max g's During Ascent	3.46g
Insertion Altitude	130.0nmi (240.8km)

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	219,080lb (99,373kg) †
Payload w/ additional 10% Reserve	197,172lb (89,436kg) †



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW

Payload Fairing	4,789,235lb (2,172,360kg)
Payload Envelope	27.6 x 0.0ft (8.4 x 0.0m)
Payload Fairing Jettison Mass	25.0 x 0.0ft (7.6 x 0.0m)
Payload Fairing Jettison	8,724lb (3,957kg)
Launch Abort System Jettison Mass	329.9s @ 71.9nmi
Launch Abort System Jettison	-

BOOSTERS (each)

Design Heritage	Shuttle RSRM - Flown Unchanged
Propellants	PBAN
Usable Propellant	1,111,604lb (504,215kg)
Stage pmf	0.8561
Dry Mass	183,948lb (83,437kg)
Burnout Mass	186,864lb (84,760kg)
# Boosters / Type	2 / 4-segment Shuttle RSRM
Booster Thrust (@ 0.7s) SL	2,892,912lbf (1,312,203kgf / 12,868,314N)
Vac	3,142,302lbf (1,425,324kgf / 13,977,656N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	269.1s
Booster Burn Time	123.8s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	8,748lb (3,968kg)
----------	-------------------

EDS TLI PERFORMANCE

2-Launch EOR	3,220.0m/s (+ FPR)
TLI dV (Adj. for Gravity Losses)	5.0 days
LEO Loiter Period	162,469lb (73,695kg) ‡
TLI Payload Performance*	

Work In Progress

6th June 2009

* ASE is part of the Payload, not additional

† Ascent Performance for Jupiter-246 protects for Upper Stage Single-Engine-Out and full FPR

‡ TLI Performance for Jupiter-246 protects for Upper Stage Dual-Engine-Out and full FPR

Vehicle Concept Characteristics - LV 41.4003.10050

UPPER STAGE

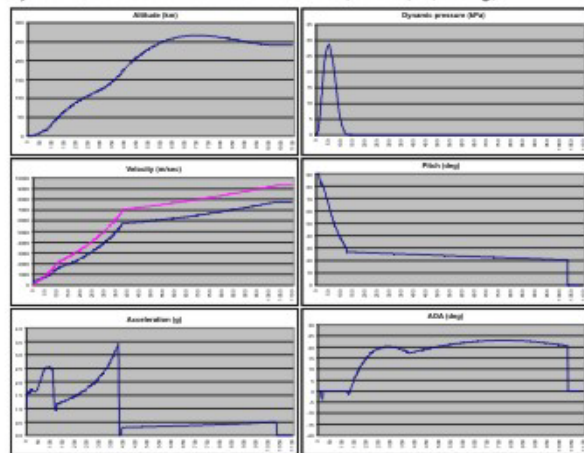
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	379,321lb (172,057kg)
Usable Ascent Propellant	151,961lb (68,928kg)
Ascent Flight Performance Reserve	6,418lb (2,911kg)
Usable Post-Ascent Propellant	-
Post-Ascent Flight Performance Reserve	-
Unusable Residuals	3,735lb (1,694kg)
Ascent In-Flight Losses	220lb (100kg)
RCS Propellant	992lb (450kg)
Propellant Offload	56.63%
Stage pmf	0.9342
Dry Mass	22,737lb (10,313kg)
Burnout Mass	26,473lb (12,008kg)
# Engines / Type	6 / RL-10A-4-2
Engine Thrust (@ 100%) Vac	22,300lbf (10,115kgf / 99,195N)
Engine Isp (@ 100%) Vac	445.2s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	646.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	-
ASE*	3,064lb (1,390kg)

DYNAMICS

Thrust : Weight @ Liftoff	Blackzone Safe Trajectory
Max Dynamic Pressure	1.535 : 1
Max g's During Ascent	599.0psf (28,678Pa)
Insertion Altitude	3.40g
	130.0nmi (240.8km)

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	200,903lb (91,128kg) †
Payload w/ additional 10% Reserve	180,812lb (82,015kg) †



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW

Payload Fairing	4,790,986lb (2,173,155kg)
Payload Envelope	32.8 x 18.4ft (10.0 x 5.6m)
Payload Fairing Jettison Mass	30.2 x 18.4ft (9.2 x 5.6m)
Payload Fairing Jettison	12,571lb (5,702kg)
Launch Abort System Jettison	After Orbital Insertion
Launch Abort System Jettison	16,083lb (7,295kg)
Launch Abort System Jettison	405.0s @ 96.7nmi

BOOSTERS (each)

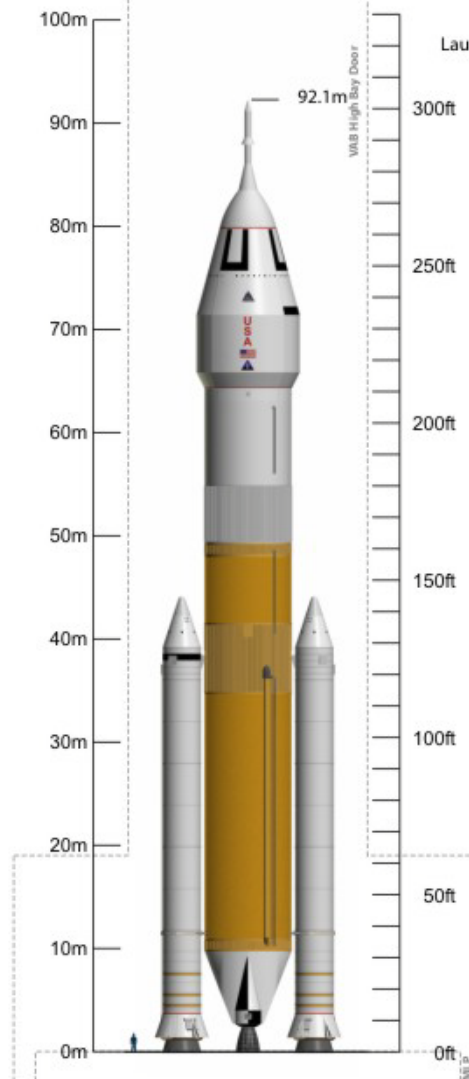
Design Heritage	Shuttle RSRM - Flown Unchanged
Propellants	PBAN
Usable Propellant	1,111,604lb (504,215kg)
Stage pmf	0.8561
Dry Mass	183,948lb (83,437kg)
Burnout Mass	186,864lb (84,760kg)
# Boosters / Type	2 / 4-segment Shuttle RSRM
Booster Thrust (@ 0.7s) SL	2,892,912lbf (1,312,203kgf / 12,868,314N)
Vac	3,142,302lbf (1,425,324kgf / 13,977,656N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	269.1s
Booster Burn Time	123.8s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	8,748lb (3,968kg)
----------	-------------------



Work In Progress

6th June 2009

* ASE is part of the Payload, not additional

† Ascent Performance for Jupiter-246 protects for Upper Stage Single-Engine-Out and full FPR

Vehicle Concept Characteristics - LV 41.4003.10051

UPPER STAGE

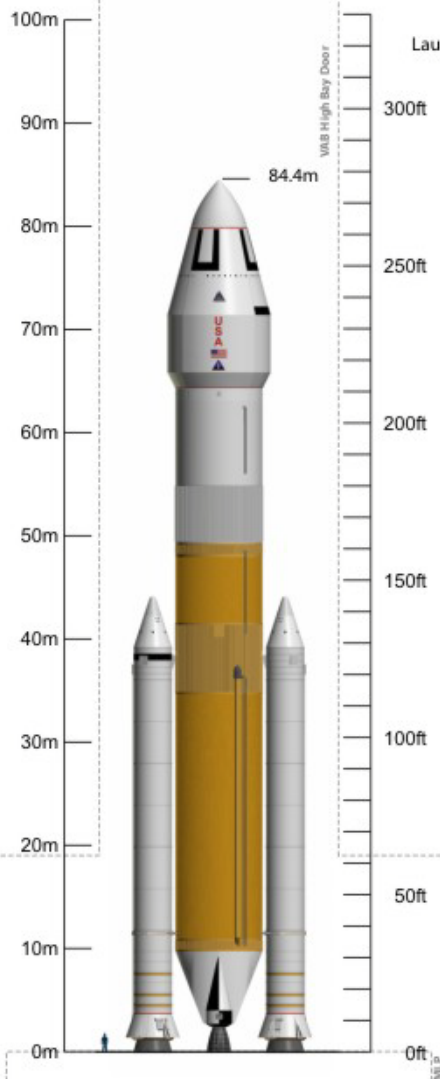
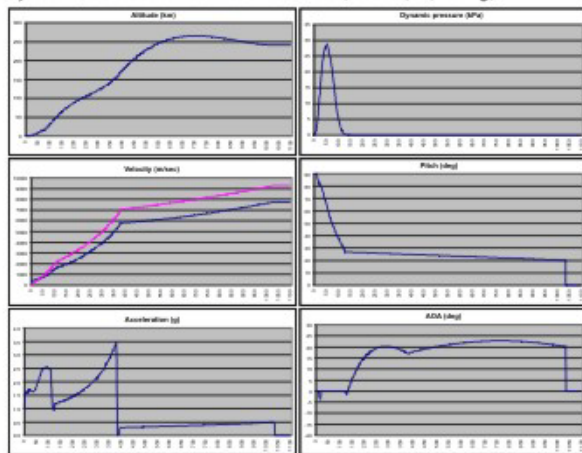
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	379,321lb (172,057kg)
Usable Ascent Propellant	151,961lb (68,928kg)
Ascent Flight Performance Reserve	6,418lb (2,911kg)
Usable Post-Ascent Propellant	-
Post-Ascent Flight Performance Reserve	-
Unusable Residuals	3,735lb (1,694kg)
Ascent In-Flight Losses	220lb (100kg)
RCS Propellant	992lb (450kg)
Propellant Offload	56.63%
Stage pmf	0.9342
Dry Mass	22,737lb (10,313kg)
Burnout Mass	26,473lb (12,008kg)
# Engines / Type	6 / RL-10A-4-2
Engine Thrust (@ 100%) Vac	22,300lbf (10,115kgf / 99,195N)
Engine Isp (@ 100%) Vac	445.2s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	646.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	-
ASE*	1,102lb (500kg)

DYNAMICS

Thrust : Weight @ Liftoff	1.534 : 1
Max Dynamic Pressure	599.0psf (28,678Pa)
Max g's During Ascent	3.47g
Insertion Altitude	130.0nmi (240.8km)

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	216,733lb (98,308kg) †
Payload w/ additional 10% Reserve	195,060lb (88,478kg) †



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW

Payload Fairing	4,794,079lb (2,174,558kg)
Payload Envelope	32.8 x 18.4ft (10.0 x 5.6m)
Payload Fairing Jettison Mass	30.2 x 18.4ft (9.2 x 5.6m)
Payload Fairing Jettison	15,916lb (7,219kg)
Launch Abort System Jettison Mass	329.4s @ 71.9nmi
Launch Abort System Jettison	-

BOOSTERS (each)

Design Heritage	Shuttle RSRM - Flown Unchanged
Propellants	PBAN
Usable Propellant	1,111,604lb (504,215kg)
Stage pmf	0.8561
Dry Mass	183,948lb (83,437kg)
Burnout Mass	186,864lb (84,760kg)
# Boosters / Type	2 / 4-segment Shuttle RSRM
Booster Thrust (@ 0.7s) SL	2,892,912lbf (1,312,203kgf / 12,868,314N)
Vac	3,142,302lbf (1,425,324kgf / 13,977,656N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	269.1s
Booster Burn Time	123.8s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	8,748lb (3,968kg)
----------	-------------------

Work In Progress

6th June 2009

* ASE is part of the Payload, not additional

† Ascent Performance for Jupiter-246 protects for Upper Stage Single-Engine-Out and full FPR



DIRECT - Phase 2

Exploration Operations

Launch Vehicle Option D
(Recommended)

Jupiter-246
(RL-10B-2)

Vehicle Concept Characteristics - LV 41.4004.08001

UPPER STAGE

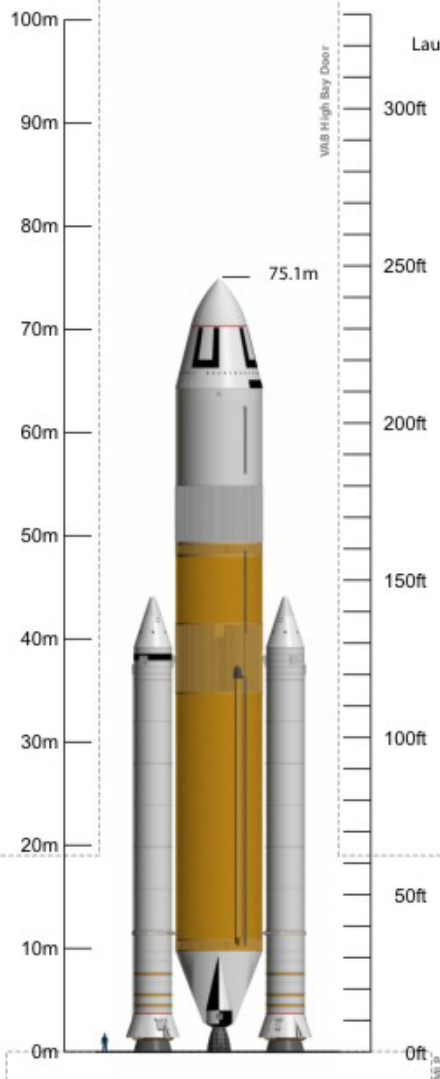
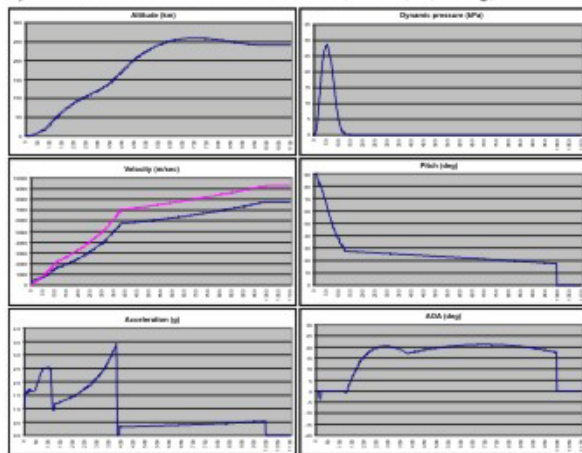
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	386,953lb (175,519kg)
Usable Ascent Propellant	154,086lb (69,892kg)
Ascent Flight Performance Reserve	6,384lb (2,896kg)
Usable Post-Ascent Propellant	220,234lb (99,896kg)
Post-Ascent Flight Performance Reserve	2,225lb (1,009kg)
Unusable Residuals	3,799lb (1,723kg)
Ascent In-Flight Losses	225lb (102kg)
RCS Propellant	992lb (450kg)
Propellant Offload	0.00%
Stage pmf	0.9306
Dry Mass	24,777lb (11,238kg)
Burnout Mass	28,576lb (12,962kg)
# Engines / Type	6 / RL-10B-2
Engine Thrust (@ 100%) Vac	24,750lbf (11,226kgf / 110,093N)
Engine Isp (@ 100%) Vac	459.0s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	609.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	6,384lb (2,896kg)
ASE*	1,102lb (500kg)

DYNAMICS

Thrust : Weight @ Liftoff	1.533 : 1
Max Dynamic Pressure	599.0psf (28,678Pa)
Max g's During Ascent	3.40g
Insertion Altitude	130.0nmi (240.8km)

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	224,553lb (101,856kg) †
Payload w/ additional 10% Reserve	202,098lb (91,670kg) †



Launch Site KSC LC-39 (Latitude: 28.6084°)

GLOW	4,798,961lb (2,176,772kg)
Payload Fairing	27.6 x 0.0ft (8.4 x 0.0m)
Payload Envelope	25.0 x 0.0ft (7.6 x 0.0m)
Payload Fairing Jettison Mass	8,724lb (3,957kg)
Payload Fairing Jettison	334.8s @ 72.0nmi
Launch Abort System Jettison Mass	-
Launch Abort System Jettison	-
BOOSTERS (each)	
Design Heritage	Shuttle RSRM - Flown Unchanged
Propellants	PBAN
Usable Propellant	1,111,604lb (504,215kg)
Stage pmf	0.8561
Dry Mass	183,948lb (83,437kg)
Burnout Mass	186,864lb (84,760kg)
# Boosters / Type	2 / 4-segment Shuttle RSRM
Booster Thrust (@ 0.7s) SL	2,892,912lbf (1,312,203kgf / 12,868,314N)
Vac	3,142,302lbf (1,425,324kgf / 13,977,656N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	269.1s
Booster Burn Time	123.8s
CORE STAGE	
Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s
INTERSTAGE	
Dry Mass	8,748lb (3,968kg)
EDS TLI PERFORMANCE	
2-Launch EOR	3,215.0m/s (+ FPR)
TLI dV (Adj. for Gravity Losses)	5.0 days
LEO Loiter Period	
TLI Payload Performance*	174,282lb (79,053kg) ‡

Work In Progress

6th June 2009

* ASE is part of the Payload, not additional

† Ascent Performance for Jupiter-246 protects for Upper Stage Single-Engine-Out and full FPR

‡ TLI Performance for Jupiter-246 protects for Upper Stage Dual-Engine-Out and full FPR

Vehicle Concept Characteristics - LV 41.4004.10050

UPPER STAGE

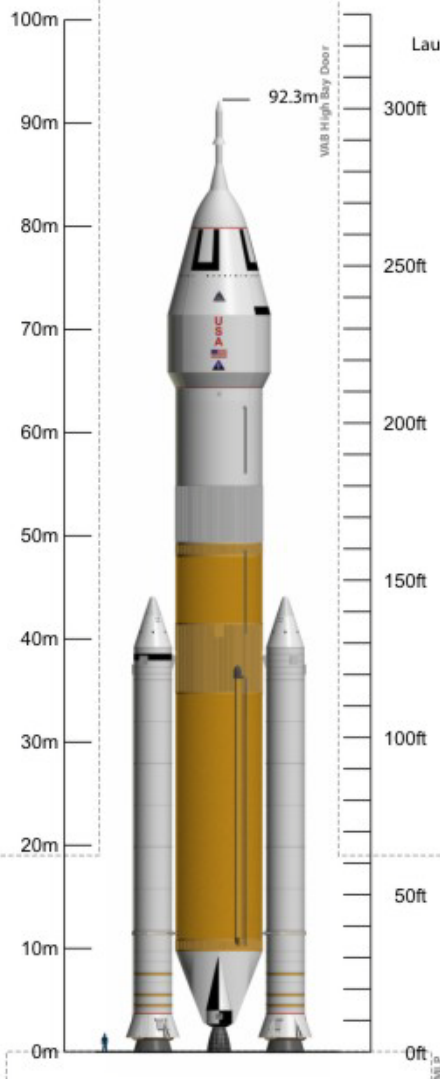
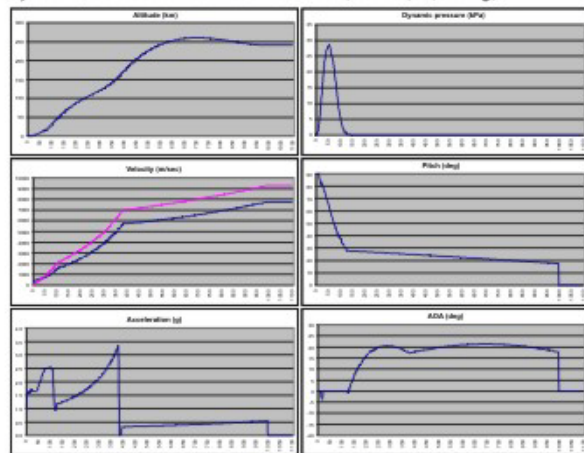
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	386,953lb (175,519kg)
Usable Ascent Propellant	154,086lb (69,892kg)
Ascent Flight Performance Reserve	6,384lb (2,896kg)
Usable Post-Ascent Propellant	-
Post-Ascent Flight Performance Reserve	-
Unusable Residuals	3,799lb (1,723kg)
Ascent In-Flight Losses	225lb (102kg)
RCS Propellant	992lb (450kg)
Propellant Offload	56.91%
Stage pmf	0.9306
Dry Mass	24,777lb (11,238kg)
Burnout Mass	28,576lb (12,962kg)
# Engines / Type	6 / RL-10B-2
Engine Thrust (@ 100%) Vac	24,750lbf (11,226kgf / 110,093N)
Engine Isp (@ 100%) Vac	459.0s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	609.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	-
ASE*	3,064lb (1,390kg)

DYNAMICS

Thrust : Weight @ Liftoff	Blackzone Safe Trajectory
Max Dynamic Pressure	1.532 : 1
Max g's During Ascent	599.0psf (28,678Pa)
Insertion Altitude	3.34g
	130.0nmi (240.8km)

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	206,560lb (93,694kg) †
Payload w/ additional 10% Reserve	185,904lb (84,325kg) †



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW

Payload Fairing	4,800,897lb (2,177,650kg)
Payload Envelope	32.8 x 18.4ft (10.0 x 5.6m)
Payload Fairing Jettison Mass	30.2 x 18.4ft (9.2 x 5.6m)
Payload Fairing Jettison	12,571lb (5,702kg)
Launch Abort System Jettison Mass	After Orbital Insertion
Launch Abort System Jettison	16,083lb (7,295kg)
	405.0s @ 95.2nmi

BOOSTERS (each)

Design Heritage	Shuttle RSRM - Flown Unchanged
Propellants	PBAN
Usable Propellant	1,111,604lb (504,215kg)
Stage pmf	0.8561
Dry Mass	183,948lb (83,437kg)
Burnout Mass	186,864lb (84,760kg)
# Boosters / Type	2 / 4-segment Shuttle RSRM
Booster Thrust (@ 0.7s) SL	2,892,912lbf (1,312,203kgf / 12,868,314N)
Vac	3,142,302lbf (1,425,324kgf / 13,977,656N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	269.1s
Booster Burn Time	123.8s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	8,748lb (3,968kg)
----------	-------------------

Work In Progress

6th June 2009

* ASE is part of the Payload, not additional

† Ascent Performance for Jupiter-246 protects for Upper Stage Single-Engine-Out and full FPR

Vehicle Concept Characteristics - LV 41.4004.10051

UPPER STAGE

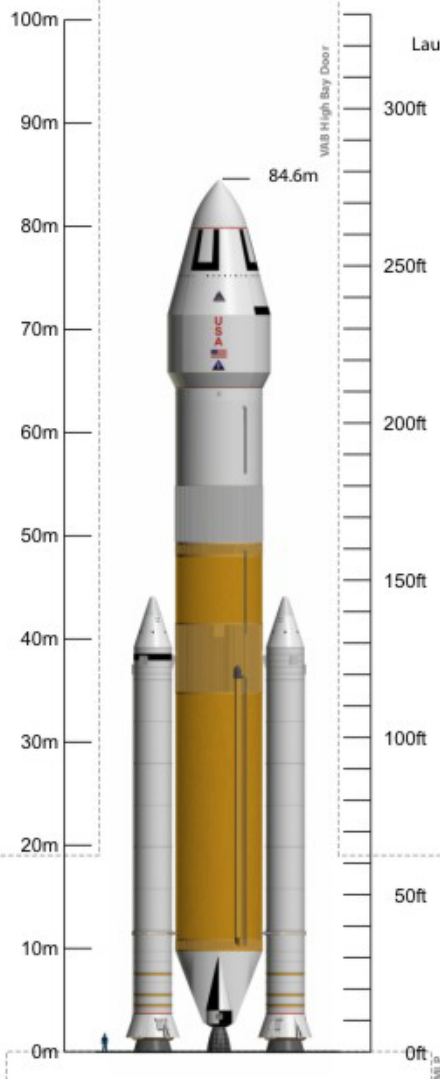
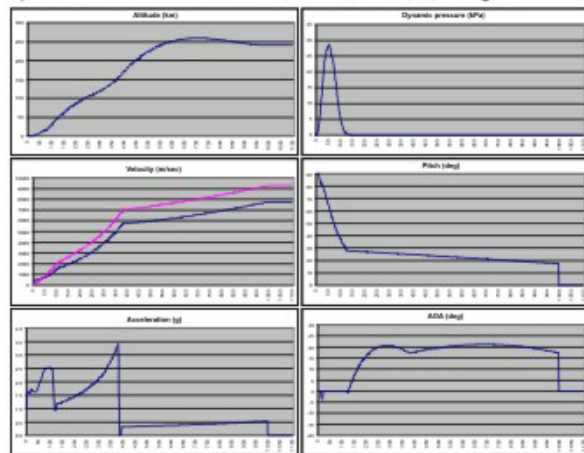
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	386,953lb (175,519kg)
Usable Ascent Propellant	154,086lb (69,892kg)
Ascent Flight Performance Reserve	6,384lb (2,896kg)
Usable Post-Ascent Propellant	-
Post-Ascent Flight Performance Reserve	-
Unusable Residuals	3,799lb (1,723kg)
Ascent In-Flight Losses	225lb (102kg)
RCS Propellant	992lb (450kg)
Propellant Offload	56.91%
Stage pmf	0.9306
Dry Mass	24,777lb (11,238kg)
Burnout Mass	28,576lb (12,962kg)
# Engines / Type	6 / RL-10B-2
Engine Thrust (@ 100%) Vac	24,750lbf (11,226kgf / 110,093N)
Engine Isp (@ 100%) Vac	459.0s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	614.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	-
ASE*	1,102lb (500kg)

DYNAMICS

Thrust : Weight @ Liftoff	1.541 : 1
Max Dynamic Pressure	601.4psf (28,796Pa)
Max g's During Ascent	3.59g
Insertion Altitude	170.0nmi (314.8km)

ASCENT PERFORMANCE

Delivery Orbit	20.9 x 172.7nmi, 29.0°
Payload w/ regular NASA GR&A's	222,103lb (100,744kg) †
Payload w/ additional 10% Reserve	199,892lb (90,670kg) †



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW

Payload Fairing	4,803,702lb (2,178,923kg)
Payload Envelope	32.8 x 18.4ft (10.0 x 5.6m)
Payload Fairing Jettison Mass	30.2 x 18.4ft (9.2 x 5.6m)
Payload Fairing Jettison	15,916lb (7,219kg)
Launch Abort System Jettison Mass	334.4s @ 72.3nmi
Launch Abort System Jettison	-

BOOSTERS (each)

Design Heritage	Shuttle RSRM - Flown Unchanged
Propellants	PBAN
Usable Propellant	1,111,604lb (504,215kg)
Stage pmf	0.8561
Dry Mass	183,948lb (83,437kg)
Burnout Mass	186,864lb (84,760kg)
# Boosters / Type	2 / 4-segment Shuttle RSRM
Booster Thrust (@ 0.7s) SL	2,892,912lbf (1,312,203kgf / 12,868,314N)
Vac	3,142,302lbf (1,425,324kgf / 13,977,656N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	269.1s
Booster Burn Time	123.8s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	8,748lb (3,968kg)
----------	-------------------

Work In Progress

6th June 2009

* ASE is part of the Payload, not additional

† Ascent Performance for Jupiter-246 protects for Upper Stage Single-Engine-Out and full FPR



DIRECT - Phase 2

Exploration Operations

Launch Vehicle Option E

Jupiter-247
(RL-10A-4-2)

Vehicle Concept Characteristics - LV 41.4003.08001

UPPER STAGE

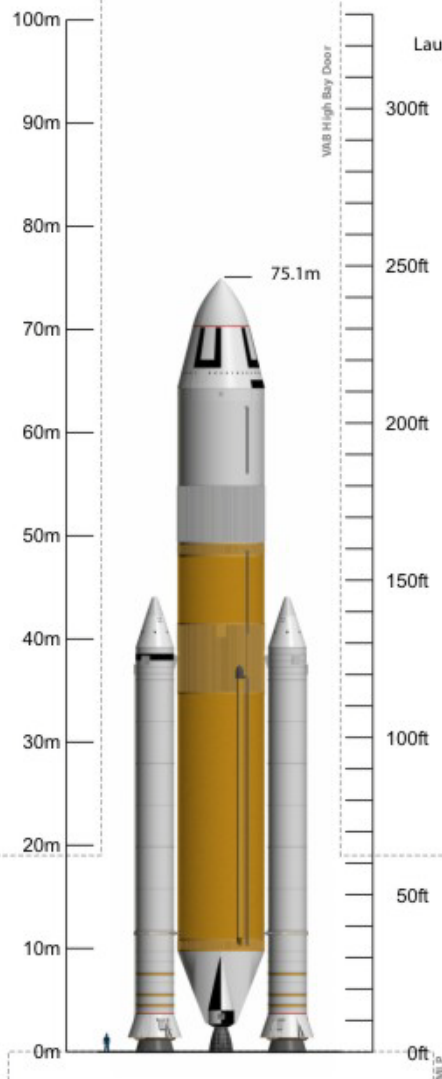
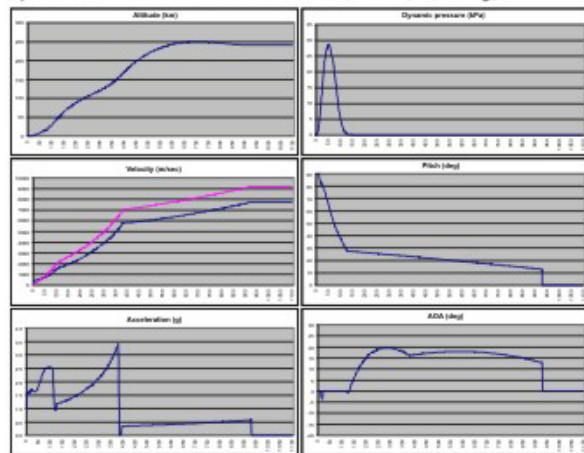
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	385,805lb (174,998kg)
Usable Ascent Propellant	152,399lb (69,127kg)
Ascent Flight Performance Reserve	6,494lb (2,946kg)
Usable Post-Ascent Propellant	220,634lb (100,078kg)
Post-Ascent Flight Performance Reserve	2,229lb (1,011kg)
Unusable Residuals	3,788lb (1,718kg)
Ascent In-Flight Losses	261lb (118kg)
RCS Propellant	992lb (450kg)
Propellant Offload	0.00%
Stage pmf	0.9336
Dry Mass	23,372lb (10,601kg)
Burnout Mass	27,160lb (12,320kg)
# Engines / Type	7 / RL-10A-4-2
Engine Thrust (@ 100%) Vac	22,300lbf (10,115kgf / 99,195N)
Engine Isp (@ 100%) Vac	445.2s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	541.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	6,494lb (2,946kg)
ASE*	1,102lb (500kg)

DYNAMICS

Thrust : Weight @ Liftoff	1.534 : 1
Max Dynamic Pressure	599.0psf (28,678Pa)
Max g's During Ascent	3.42g
Insertion Altitude	130.0nmi (240.8km)

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	224,957lb (102,039kg) †
Payload w/ additional 10% Reserve	202,462lb (91,835kg) †



Launch Site KSC LC-39 (Latitude: 28.6084°)

GLOW	4,796,412lb (2,175,616kg)
Payload Fairing	27.6 x 0.0ft (8.4 x 0.0m)
Payload Envelope	25.0 x 0.0ft (7.6 x 0.0m)
Payload Fairing Jettison Mass	8,724lb (3,957kg)
Payload Fairing Jettison	335.9s @ 72.2nmi
Launch Abort System Jettison Mass	-
Launch Abort System Jettison	-
BOOSTERS (each)	
Design Heritage	Shuttle RSRM - Flown Unchanged
Propellants	PBAN
Usable Propellant	1,111,604lb (504,215kg)
Stage pmf	0.8561
Dry Mass	183,948lb (83,437kg)
Burnout Mass	186,864lb (84,760kg)
# Boosters / Type	2 / 4-segment Shuttle RSRM
Booster Thrust (@ 0.7s) SL	2,892,912lbf (1,312,203kgf / 12,868,314N)
Vac	3,142,302lbf (1,425,324kgf / 13,977,656N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	269.1s
Booster Burn Time	123.8s
CORE STAGE	
Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s
INTERSTAGE	
Dry Mass	8,748lb (3,968kg)
EDS TLI PERFORMANCE	
2-Launch EOR	
TLI dV (Adj. for Gravity Losses)	3,205.0m/s (+ FPR)
LEO Loiter Period	5.0 days
TLI Payload Performance*	168,274lb (76,328kg) ‡

Work In Progress

6th June 2009

* ASE is part of the Payload, not additional

† Ascent Performance for Jupiter-247 protects for Upper Stage Single-Engine-Out and full FPR

‡ TLI Performance for Jupiter-247 protects for Upper Stage Dual-Engine-Out and full FPR

Vehicle Concept Characteristics - LV 41.4003.10050

UPPER STAGE

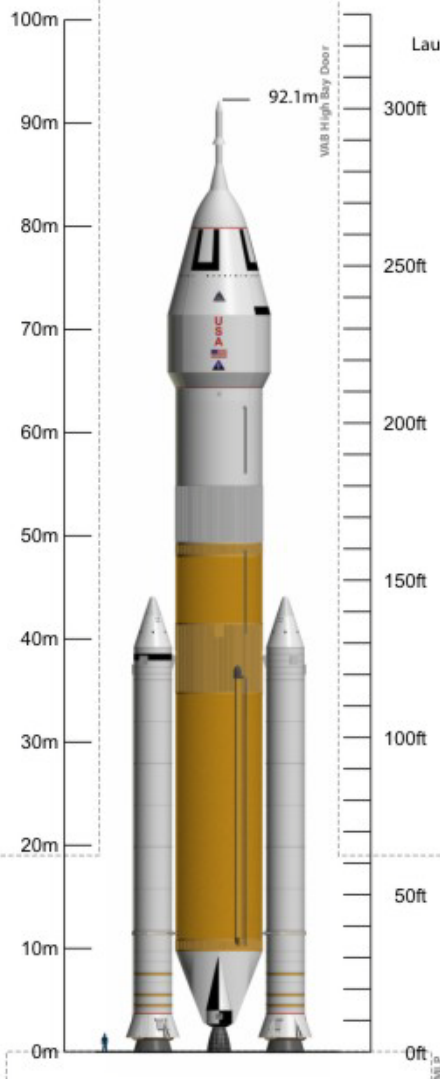
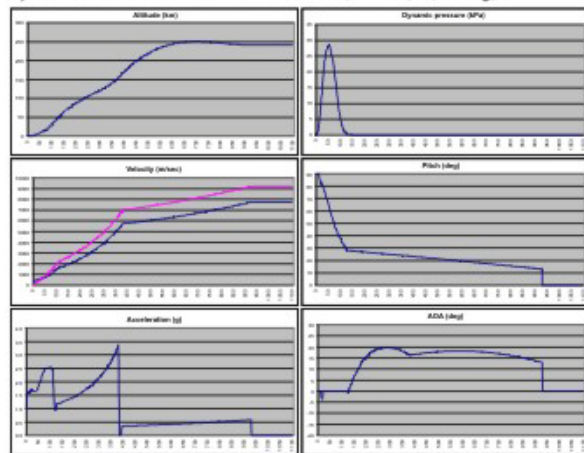
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	385,805lb (174,998kg)
Usable Ascent Propellant	152,399lb (69,127kg)
Ascent Flight Performance Reserve	6,494lb (2,946kg)
Usable Post-Ascent Propellant	-
Post-Ascent Flight Performance Reserve	-
Unusable Residuals	3,788lb (1,718kg)
Ascent In-Flight Losses	261lb (118kg)
RCS Propellant	992lb (450kg)
Propellant Offload	57.19%
Stage pmf	0.9336
Dry Mass	23,372lb (10,601kg)
Burnout Mass	27,160lb (12,320kg)
# Engines / Type	7 / RL-10A-4-2
Engine Thrust (@ 100%) Vac	22,300lbf (10,115kgf / 99,195N)
Engine Isp (@ 100%) Vac	445.2s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	541.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	-
ASE*	3,064lb (1,390kg)

DYNAMICS

Thrust : Weight @ Liftoff	Blackzone Safe Trajectory
Max Dynamic Pressure	1.533 : 1
Max g's During Ascent	599.0psf (28,678Pa)
Insertion Altitude	3.36g
	130.0nmi (240.8km)

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	206,997lb (93,892kg) †
Payload w/ additional 10% Reserve	186,298lb (84,503kg) †



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW

Payload Fairing	4,798,382lb (2,176,509kg)
Payload Envelope	32.8 x 18.4ft (10.0 x 5.6m)
Payload Fairing Jettison Mass	30.2 x 18.4ft (9.2 x 5.6m)
Payload Fairing Jettison	12,571lb (5,702kg)
Launch Abort System Jettison	After Orbital Insertion
Launch Abort System Jettison	16,083lb (7,295kg)
Launch Abort System Jettison	405.0s @ 93.7nmi

BOOSTERS (each)

Design Heritage	Shuttle RSRM - Flown Unchanged
Propellants	PBAN
Usable Propellant	1,111,604lb (504,215kg)
Stage pmf	0.8561
Dry Mass	183,948lb (83,437kg)
Burnout Mass	186,864lb (84,760kg)
# Boosters / Type	2 / 4-segment Shuttle RSRM
Booster Thrust (@ 0.7s) SL	2,892,912lbf (1,312,203kgf / 12,868,314N)
Vac	3,142,302lbf (1,425,324kgf / 13,977,656N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	269.1s
Booster Burn Time	123.8s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	8,748lb (3,968kg)
----------	-------------------

Work In Progress

6th June 2009

* ASE is part of the Payload, not additional

† Ascent Performance for Jupiter-247 protects for Upper Stage Single-Engine-Out and full FPR

Vehicle Concept Characteristics - LV 41.4003.10051

UPPER STAGE

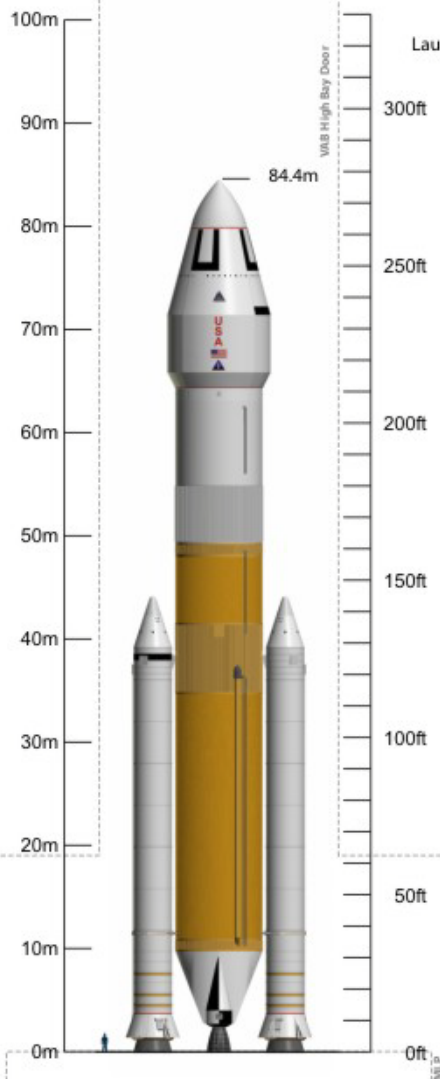
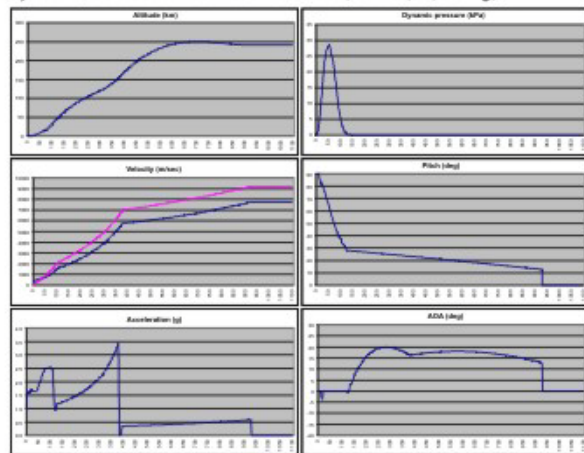
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	385,805lb (174,998kg)
Usable Ascent Propellant	152,399lb (69,127kg)
Ascent Flight Performance Reserve	6,494lb (2,946kg)
Usable Post-Ascent Propellant	-
Post-Ascent Flight Performance Reserve	-
Unusable Residuals	3,788lb (1,718kg)
Ascent In-Flight Losses	261lb (118kg)
RCS Propellant	992lb (450kg)
Propellant Offload	57.19%
Stage pmf	0.9336
Dry Mass	23,372lb (10,601kg)
Burnout Mass	27,160lb (12,320kg)
# Engines / Type	7 / RL-10A-4-2
Engine Thrust (@ 100%) Vac	22,300lbf (10,115kgf / 99,195N)
Engine Isp (@ 100%) Vac	445.2s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	541.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	-
ASE*	1,102lb (500kg)

DYNAMICS

Thrust : Weight @ Liftoff	1.532 : 1
Max Dynamic Pressure	599.0psf (28,678Pa)
Max g's During Ascent	3.43g
Insertion Altitude	130.0nmi (240.8km)

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	222,501lb (100,925kg) †
Payload w/ additional 10% Reserve	200,251lb (90,832kg) †



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW

Payload Fairing	4,801,148lb (2,177,764kg)
Payload Envelope	32.8 x 18.4ft (10.0 x 5.6m)
Payload Fairing Jettison Mass	30.2 x 18.4ft (9.2 x 5.6m)
Payload Fairing Jettison	15,916lb (7,219kg)
Launch Abort System Jettison Mass	335.5s @ 72.2nmi
Launch Abort System Jettison	-

BOOSTERS (each)

Design Heritage	Shuttle RSRM - Flown Unchanged
Propellants	PBAN
Usable Propellant	1,111,604lb (504,215kg)
Stage pmf	0.8561
Dry Mass	183,948lb (83,437kg)
Burnout Mass	186,864lb (84,760kg)
# Boosters / Type	2 / 4-segment Shuttle RSRM
Booster Thrust (@ 0.7s) SL	2,892,912lbf (1,312,203kgf / 12,868,314N)
Vac	3,142,302lbf (1,425,324kgf / 13,977,656N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	269.1s
Booster Burn Time	123.8s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	8,748lb (3,968kg)
----------	-------------------

Work In Progress

6th June 2009

* ASE is part of the Payload, not additional

† Ascent Performance for Jupiter-247 protects for Upper Stage Single-Engine-Out and full FPR



DIRECT - Phase 2

Exploration Operations

Launch Vehicle Option F

Jupiter-241 Heavy
(J-2X)

Vehicle Concept Characteristics - LV 41.5002.08001

UPPER STAGE

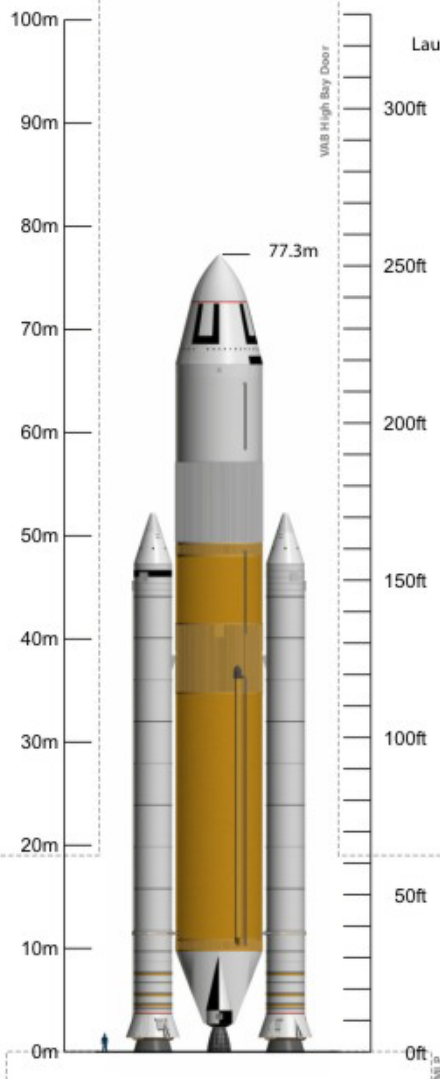
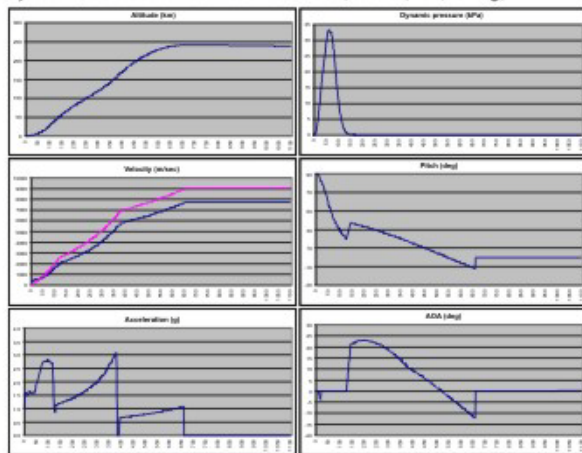
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	438,746lb (199,012kg)
Usable Ascent Propellant	164,736lb (74,723kg)
Ascent Flight Performance Reserve	7,309lb (3,315kg)
Usable Post-Ascent Propellant	259,814lb (117,850kg)
Post-Ascent Flight Performance Reserve	2,624lb (1,190kg)
Unusable Residuals	4,220lb (1,914kg)
Ascent In-Flight Losses	42lb (19kg)
RCS Propellant	992lb (450kg)
Propellant Offload	0.00%
Stage pmf	0.9303
Dry Mass	28,314lb (12,843kg)
Burnout Mass	32,534lb (14,757kg)
# Engines / Type	1 / J-2X
Engine Thrust (@ 100%) Vac	294,000lbf (133,356kgf / 1,307,777N)
Engine Isp (@ 100%) Vac	448.0s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	271.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	7,309lb (3,315kg)
ASE*	1,102lb (500kg)

DYNAMICS

Thrust : Weight @ Liftoff	1.512 : 1
Max Dynamic Pressure	698.6psf (33,449Pa)
Max g's During Ascent	3.10g
Insertion Altitude	130.0nmi (240.8km)

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	264,533lb (119,990kg)
Payload w/ additional 10% Reserve	238,079lb (107,991kg)



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW

Payload Fairing	5,750,543lb (2,608,402kg)
Payload Envelope	27.6 x 0.0ft (8.4 x 0.0m)
Payload Fairing Jettison Mass	25.0 x 0.0ft (7.6 x 0.0m)
Payload Fairing Jettison	8,724lb (3,957kg)
Launch Abort System Jettison Mass	335.5s @ 72.5nmi
Launch Abort System Jettison	-

BOOSTERS (each)

Design Heritage	Shuttle-derived 5-segment RSRMV
Propellants	PBAN
Usable Propellant	1,380,873lb (626,353kg)
Stage pmf	0.8656
Dry Mass	228,620lb (103,700kg)
Burnout Mass	232,608lb (105,509kg)
# Boosters / Type	2 / 5-segment RSRMV
Booster Thrust (@ 0.7s) SL	3,510,791lbf (1,592,468kgf / 15,616,776N)
Vac	3,510,791lbf (1,592,468kgf / 15,616,776N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	267.4s
Booster Burn Time	126.6s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	11,664lb (5,291kg)
----------	--------------------

EDS TLI PERFORMANCE

2-Launch EOR	3,175.0m/s (+ FPR)
TLI dV (Adj. for Gravity Losses)	5.0 days
LEO Loiter Period	203,066lb (92,109kg)
TLI Payload Performance*	

Work In Progress

8th June 2009

* ASE is part of the Payload, not additional

Vehicle Concept Characteristics - LV 41.5002.10050

UPPER STAGE

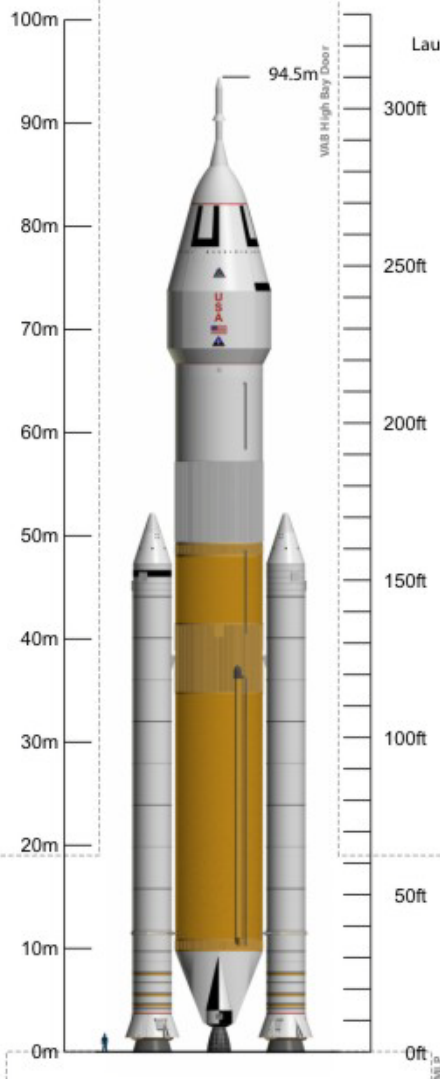
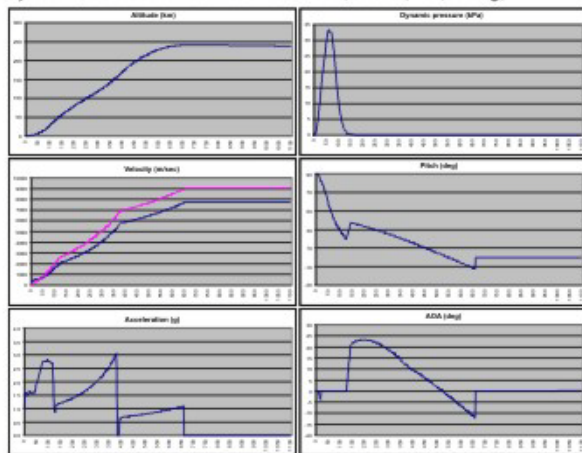
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	438,746lb (199,012kg)
Usable Ascent Propellant	164,736lb (74,723kg)
Ascent Flight Performance Reserve	7,309lb (3,315kg)
Usable Post-Ascent Propellant	-
Post-Ascent Flight Performance Reserve	-
Unusable Residuals	4,220lb (1,914kg)
Ascent In-Flight Losses	42lb (19kg)
RCS Propellant	992lb (450kg)
Propellant Offload	59.22%
Stage pmf	0.9303
Dry Mass	28,314lb (12,843kg)
Burnout Mass	32,534lb (14,757kg)
# Engines / Type	1 / J-2X
Engine Thrust (@ 100%) Vac	294,000lbf (133,356kgf / 1,307,777N)
Engine Isp (@ 100%) Vac	448.0s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	271.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	-
ASE*	3,064lb (1,390kg)

DYNAMICS

Blackzone Safe Trajectory	1.512 : 1
Thrust : Weight @ Liftoff	699.3psf (33,485Pa)
Max Dynamic Pressure	3.05g
Max g's During Ascent	130.0nmi (240.8km)
Insertion Altitude	

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	246,476lb (111,800kg)
Payload w/ additional 10% Reserve	221,828lb (100,620kg)



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW

Payload Fairing	5,752,415lb (2,609,252kg)
Payload Envelope	32.8 x 18.4ft (10.0 x 5.6m)
Payload Fairing Jettison Mass	30.2 x 18.4ft (9.2 x 5.6m)
Payload Fairing Jettison	12,571lb (5,702kg)
Launch Abort System Jettison Mass	After Orbital Insertion
Launch Abort System Jettison	16,083lb (7,295kg)
Launch Abort System Jettison	405.0s @ 93.1nmi

BOOSTERS (each)

Design Heritage	Shuttle-derived 5-segment RSRMV
Propellants	PBAN
Usable Propellant	1,380,873lb (626,353kg)
Stage pmf	0.8656
Dry Mass	228,620lb (103,700kg)
Burnout Mass	232,608lb (105,509kg)
# Boosters / Type	2 / 5-segment RSRMV
Booster Thrust (@ 0.7s) SL	3,510,791lbf (1,592,468kgf / 15,616,776N)
Vac	3,510,791lbf (1,592,468kgf / 15,616,776N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	267.4s
Booster Burn Time	126.6s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	11,664lb (5,291kg)
----------	--------------------

2-Launch EOR
3,175.0m/s (+ FPR)
5.0 days
203,066lb (92,109kg)

Work In Progress

8th June 2009

* ASE is part of the Payload, not additional

Vehicle Concept Characteristics - LV 41.5002.10051

UPPER STAGE

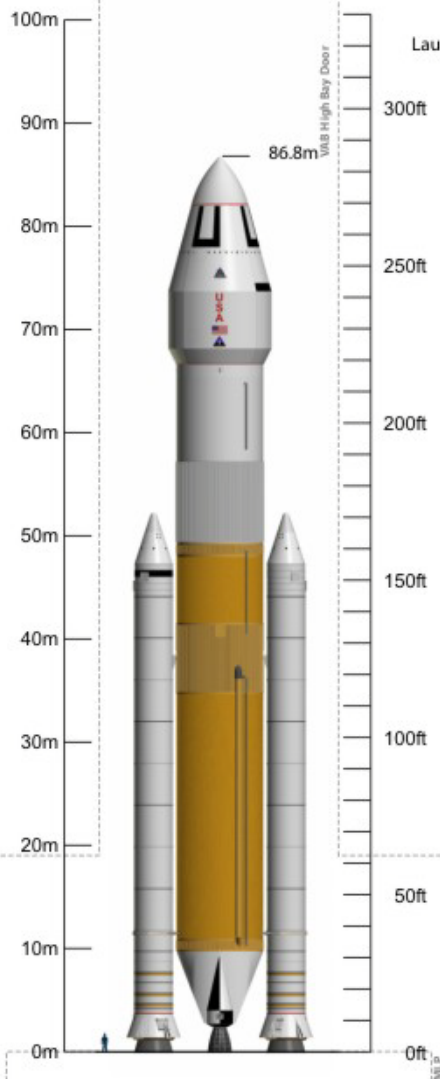
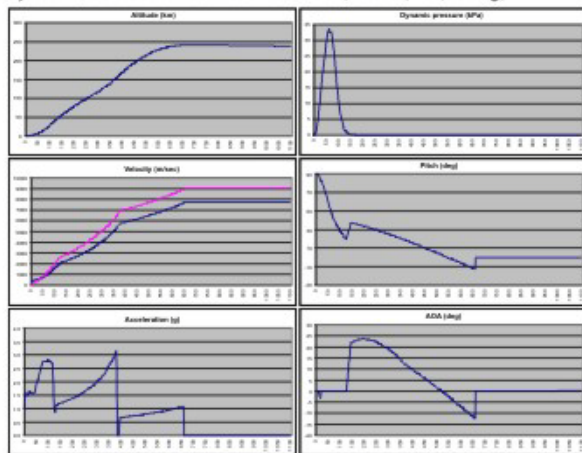
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	438,746lb (199,012kg)
Usable Ascent Propellant	164,736lb (74,723kg)
Ascent Flight Performance Reserve	7,309lb (3,315kg)
Usable Post-Ascent Propellant	-
Post-Ascent Flight Performance Reserve	-
Unusable Residuals	4,220lb (1,914kg)
Ascent In-Flight Losses	42lb (19kg)
RCS Propellant	992lb (450kg)
Propellant Offload	59.22%
Stage pmf	0.9303
Dry Mass	28,314lb (12,843kg)
Burnout Mass	32,534lb (14,757kg)
# Engines / Type	1 / J-2X
Engine Thrust (@ 100%) Vac	294,000lbf (133,356kgf / 1,307,777N)
Engine Isp (@ 100%) Vac	448.0s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	271.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	-
ASE*	1,102lb (500kg)

DYNAMICS

Thrust : Weight @ Liftoff	1.511 : 1
Max Dynamic Pressure	700.3psf (33,530Pa)
Max g's During Ascent	3.11g
Insertion Altitude	130.0nmi (240.8km)

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	261,596lb (118,658kg)
Payload w/ additional 10% Reserve	235,436lb (106,792kg)



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW

Payload Fairing	5,754,798lb (2,610,333kg)
Payload Envelope	32.8 x 18.4ft (10.0 x 5.6m)
Payload Fairing Jettison Mass	30.2 x 18.4ft (9.2 x 5.6m)
Payload Fairing Jettison	15,916lb (7,219kg)
Launch Abort System Jettison Mass	335.7s @ 72.5nmi
Launch Abort System Jettison	-

BOOSTERS (each)

Design Heritage	Shuttle-derived 5-segment RSRMV
Propellants	PBAN
Usable Propellant	1,380,873lb (626,353kg)
Stage pmf	0.8656
Dry Mass	228,620lb (103,700kg)
Burnout Mass	232,608lb (105,509kg)
# Boosters / Type	2 / 5-segment RSRMV
Booster Thrust (@ 0.7s) SL	3,510,791lbf (1,592,468kgf / 15,616,776N)
Vac	3,510,791lbf (1,592,468kgf / 15,616,776N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	267.4s
Booster Burn Time	126.6s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	11,664lb (5,291kg)
----------	--------------------

Work In Progress

8th June 2009

* ASE is part of the Payload, not additional



DIRECT - Phase 2

Exploration Operations

Launch Vehicle Option G
(Alternative Recommendation)

Jupiter-244 Heavy
(RL-60)

Vehicle Concept Characteristics - LV 41.5005.08001

UPPER STAGE

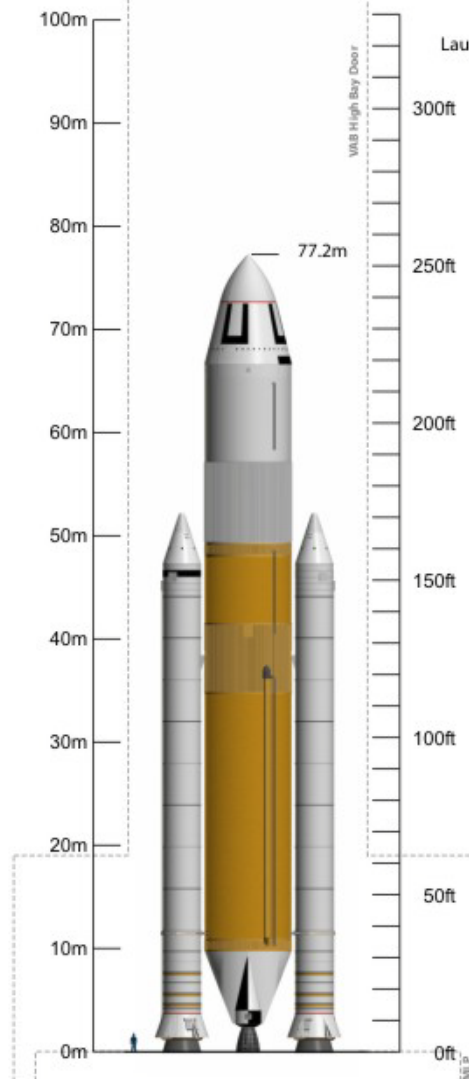
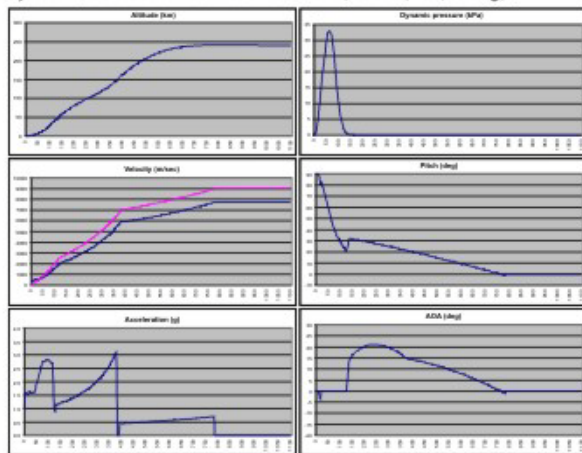
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	433,061lb (196,433kg)
Usable Ascent Propellant	156,894lb (71,166kg)
Ascent Flight Performance Reserve	7,073lb (3,208kg)
Usable Post-Ascent Propellant	262,105lb (118,889kg)
Post-Ascent Flight Performance Reserve	2,648lb (1,201kg)
Unusable Residuals	4,174lb (1,893kg)
Ascent In-Flight Losses	168lb (76kg)
RCS Propellant	992lb (450kg)
Propellant Offload	0.00%
Stage pmf	0.9322
Dry Mass	27,037lb (12,264kg)
Burnout Mass	31,211lb (14,157kg)
# Engines / Type	4 / RL-60
Engine Thrust (@ 100%) Vac	64,992lbf (29,480kgf / 289,100N)
Engine Isp (@ 100%) Vac	459.0s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	397.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	7,073lb (3,208kg)
ASE*	1,102lb (500kg)

DYNAMICS

Thrust : Weight @ Liftoff	1.514 : 1
Max Dynamic Pressure	695.9psf (33,318Pa)
Max g's During Ascent	3.13g
Insertion Altitude	130.0nmi (240.8km)

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	266,847lb (121,040kg) †
Payload w/ additional 10% Reserve	240,162lb (108,936kg) †



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW

Payload Fairing	5,743,603lb (2,605,254kg)
Payload Envelope	27.6 x 0.0ft (8.4 x 0.0m)
Payload Fairing Jettison Mass	25.0 x 0.0ft (7.6 x 0.0m)
Payload Fairing Jettison	8,724lb (3,957kg)
Launch Abort System Jettison Mass	356.0s @ 73.7nmi
Launch Abort System Jettison	-

BOOSTERS (each)

Design Heritage	Shuttle-derived 5-segment RSRMV
Propellants	PBAN
Usable Propellant	1,380,873lb (626,353kg)
Stage pmf	0.8656
Dry Mass	228,620lb (103,700kg)
Burnout Mass	232,608lb (105,509kg)
# Boosters / Type	2 / 5-segment RSRMV
Booster Thrust (@ 0.7s) SL	3,510,791lbf (1,592,468kgf / 15,616,776N)
Vac	3,510,791lbf (1,592,468kgf / 15,616,776N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	267.4s
Booster Burn Time	126.6s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	11,664lb (5,291kg)
----------	--------------------

EDS TLI PERFORMANCE

2-Launch EOR	3,205.0m/s (+ FPR)
TLI dV (Adj. for Gravity Losses)	5.0 days
LEO Loiter Period	211,762lb (96,054kg)
TLI Payload Performance*	

Work In Progress

8th June 2009

* ASE is part of the Payload, not additional

Vehicle Concept Characteristics - LV 41.5005.10050

UPPER STAGE

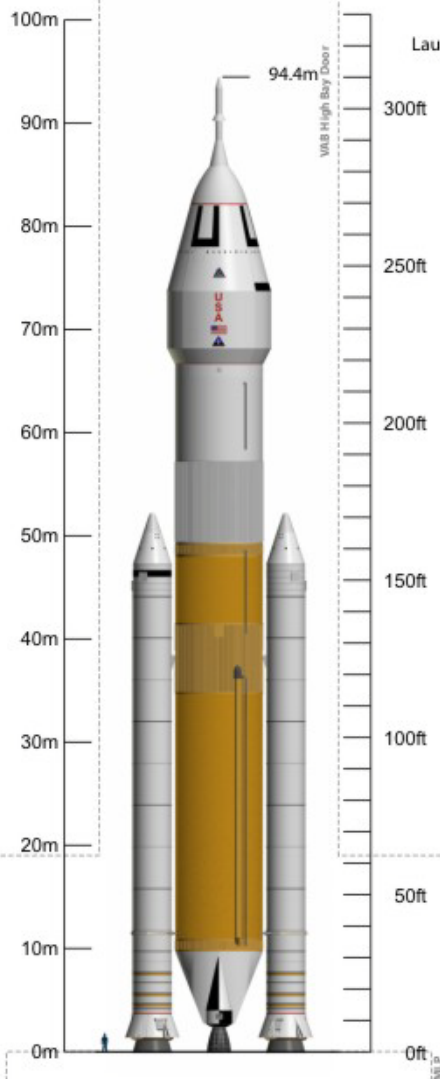
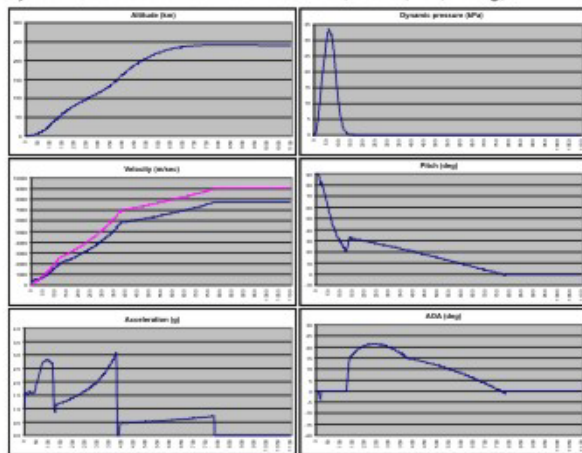
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	433,061lb (196,433kg)
Usable Ascent Propellant	156,894lb (71,166kg)
Ascent Flight Performance Reserve	7,073lb (3,208kg)
Usable Post-Ascent Propellant	-
Post-Ascent Flight Performance Reserve	-
Unusable Residuals	4,174lb (1,893kg)
Ascent In-Flight Losses	168lb (76kg)
RCS Propellant	992lb (450kg)
Propellant Offload	60.52%
Stage pmf	0.9322
Dry Mass	27,037lb (12,264kg)
Burnout Mass	31,211lb (14,157kg)
# Engines / Type	4 / RL-60
Engine Thrust (@ 100%) Vac	64,992lbf (29,480kgf / 289,100N)
Engine Isp (@ 100%) Vac	459.0s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	397.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	-
ASE*	3,064lb (1,390kg)

DYNAMICS

Thrust : Weight @ Liftoff	Blackzone Safe Trajectory
Max Dynamic Pressure	1.513 : 1
Max g's During Ascent	696.8psf (33,362Pa)
Insertion Altitude	3.07g
	130.0nmi (240.8km)

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	249,233lb (113,050kg) †
Payload w/ additional 10% Reserve	224,309lb (101,745kg) †



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW

Payload Fairing	5,745,918lb (2,606,305kg)
Payload Envelope	32.8 x 18.4ft (10.0 x 5.6m)
Payload Fairing Jettison Mass	30.2 x 18.4ft (9.2 x 5.6m)
Payload Fairing Jettison	12,571lb (5,702kg)
Launch Abort System Jettison Mass	After Orbital Insertion
Launch Abort System Jettison	16,083lb (7,295kg)
	405.0s @ 88.4nmi

BOOSTERS (each)

Design Heritage	Shuttle-derived 5-segment RSRMV
Propellants	PBAN
Usable Propellant	1,380,873lb (626,353kg)
Stage pmf	0.8656
Dry Mass	228,620lb (103,700kg)
Burnout Mass	232,608lb (105,509kg)
# Boosters / Type	2 / 5-segment RSRMV
Booster Thrust (@ 0.7s) SL	3,510,791lbf (1,592,468kgf / 15,616,776N)
Vac	3,510,791lbf (1,592,468kgf / 15,616,776N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	267.4s
Booster Burn Time	126.6s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	11,664lb (5,291kg)
----------	--------------------

Work In Progress

8th June 2009

* ASE is part of the Payload, not additional

Vehicle Concept Characteristics - LV 41.5005.10051

UPPER STAGE

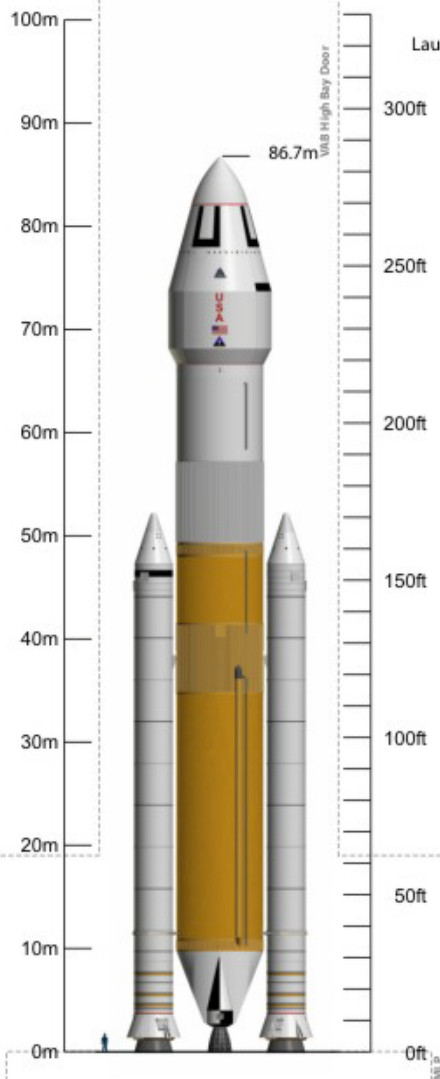
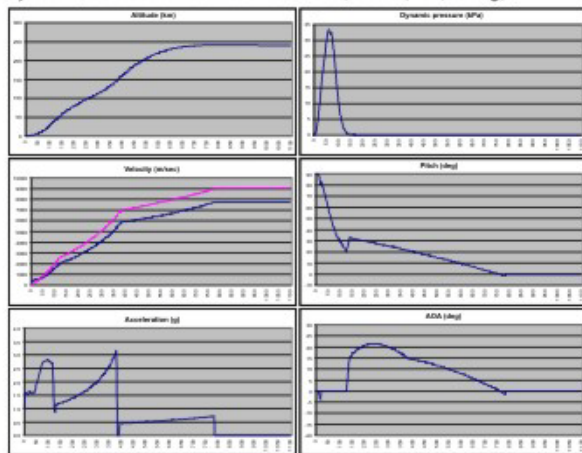
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	433,061lb (196,433kg)
Usable Ascent Propellant	156,894lb (71,166kg)
Ascent Flight Performance Reserve	7,073lb (3,208kg)
Usable Post-Ascent Propellant	-
Post-Ascent Flight Performance Reserve	-
Unusable Residuals	4,174lb (1,893kg)
Ascent In-Flight Losses	168lb (76kg)
RCS Propellant	992lb (450kg)
Propellant Offload	60.52%
Stage pmf	0.9322
Dry Mass	27,037lb (12,264kg)
Burnout Mass	31,211lb (14,157kg)
# Engines / Type	4 / RL-60
Engine Thrust (@ 100%) Vac	64,992lbf (29,480kgf / 289,100N)
Engine Isp (@ 100%) Vac	459.0s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	397.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	-
ASE*	1,102lb (500kg)

DYNAMICS

Thrust : Weight @ Liftoff	1.513 : 1
Max Dynamic Pressure	697.3psf (33,389Pa)
Max g's During Ascent	3.14g
Insertion Altitude	130.0nmi (240.8km)

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	263,406lb (119,479kg) †
Payload w/ additional 10% Reserve	237,065lb (107,531kg) †



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW

Payload Fairing	5,747,354lb (2,606,956kg)
Payload Envelope	32.8 x 18.4ft (10.0 x 5.6m)
Payload Fairing Jettison Mass	30.2 x 18.4ft (9.2 x 5.6m)
Payload Fairing Jettison	15,916lb (7,219kg)
Launch Abort System Jettison Mass	359.0s @ 73.6nmi
Launch Abort System Jettison	-

BOOSTERS (each)

Design Heritage	Shuttle-derived 5-segment RSRMV
Propellants	PBAN
Usable Propellant	1,380,873lb (626,353kg)
Stage pmf	0.8656
Dry Mass	228,620lb (103,700kg)
Burnout Mass	232,608lb (105,509kg)
# Boosters / Type	2 / 5-segment RSRMV
Booster Thrust (@ 0.7s) SL	3,510,791lbf (1,592,468kgf / 15,616,776N)
Vac	3,510,791lbf (1,592,468kgf / 15,616,776N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	267.4s
Booster Burn Time	126.6s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	11,664lb (5,291kg)
----------	--------------------

Work In Progress

8th June 2009

* ASE is part of the Payload, not additional



DIRECT - Phase 2

Exploration Operations

Launch Vehicle Option H

Jupiter-246 Heavy
(RL-10A-4-2)

Vehicle Concept Characteristics - LV 41.5003.08001

UPPER STAGE

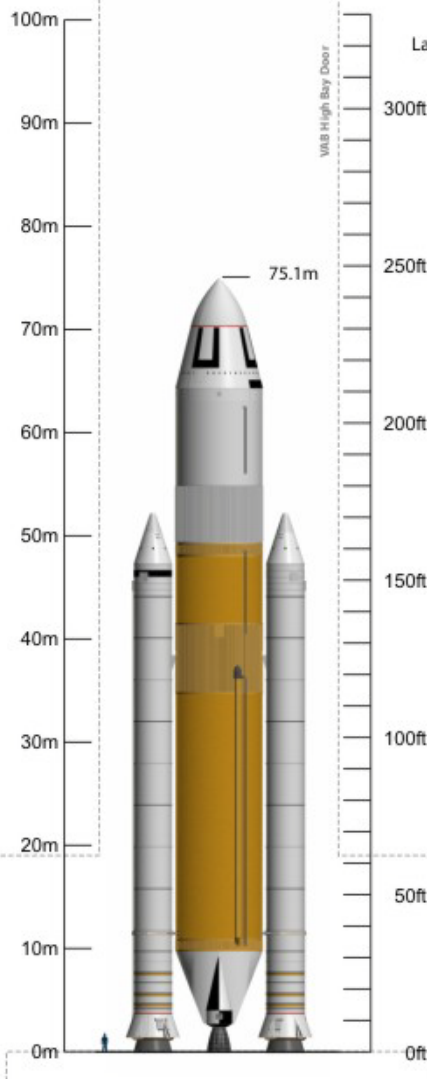
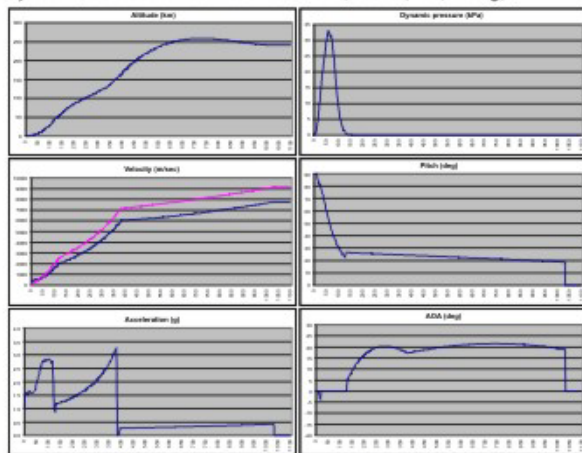
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	412,601lb (187,152kg)
Usable Ascent Propellant	150,522lb (68,276kg)
Ascent Flight Performance Reserve	6,977lb (3,165kg)
Usable Post-Ascent Propellant	248,348lb (112,649kg)
Post-Ascent Flight Performance Reserve	2,509lb (1,138kg)
Unusable Residuals	4,006lb (1,817kg)
Ascent In-Flight Losses	239lb (109kg)
RCS Propellant	992lb (450kg)
Propellant Offload	0.00%
Stage pmf	0.9357
Dry Mass	24,068lb (10,917kg)
Burnout Mass	28,074lb (12,734kg)
# Engines / Type	6 / RL-10A-4-2
Engine Thrust (@ 100%) Vac	22,300lbf (10,115kgf / 99,195N)
Engine Isp (@ 100%) Vac	445.2s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	644.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	6,977lb (3,165kg)
ASE*	1,102lb (500kg)

DYNAMICS

Thrust : Weight @ Liftoff	1.521 : 1
Max Dynamic Pressure	686.9psf (32,889Pa)
Max g's During Ascent	3.26g
Insertion Altitude	130.0nmi (240.8km)

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	252,950lb (114,736kg) †
Payload w/ additional 10% Reserve	227,655lb (103,263kg) †



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW

Payload Fairing	5,717,119lb (2,593,242kg)
Payload Envelope	27.6 x 0.0ft (8.4 x 0.0m)
Payload Fairing Jettison Mass	25.0 x 0.0ft (7.6 x 0.0m)
Payload Fairing Jettison	8,724lb (3,957kg)
Launch Abort System Jettison Mass	349.6s @ 73.5nmi
Launch Abort System Jettison	-

BOOSTERS (each)

Design Heritage	Shuttle-derived 5-segment RSRMV
Propellants	PBAN
Usable Propellant	1,380,873lb (626,353kg)
Stage pmf	0.8656
Dry Mass	228,620lb (103,700kg)
Burnout Mass	232,608lb (105,509kg)
# Boosters / Type	2 / 5-segment RSRMV
Booster Thrust (@ 0.7s) SL	3,510,791lbf (1,592,468kgf / 15,616,776N)
Vac	3,510,791lbf (1,592,468kgf / 15,616,776N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	267.4s
Booster Burn Time	126.6s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	8,748lb (3,968kg)
----------	-------------------

EDS TLI PERFORMANCE

2-Launch EOR	3,220.0m/s (+ FPR)
TLI dV (Adj. for Gravity Losses)	5.0 days
LEO Loiter Period	
TLI Payload Performance*	190,752lb (86,524kg) ‡

Work In Progress

8th June 2009

* ASE is part of the Payload, not additional

† Ascent Performance for Jupiter-246 protects for Upper Stage Single-Engine-Out and full FPR

‡ TLI Performance for Jupiter-246 protects for Upper Stage Dual-Engine-Out and full FPR

Vehicle Concept Characteristics - LV 41.5003.10050

UPPER STAGE

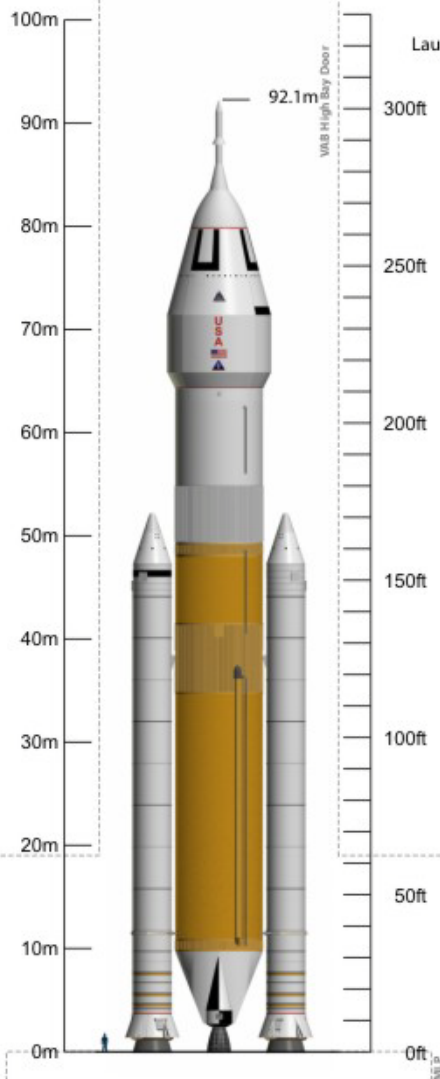
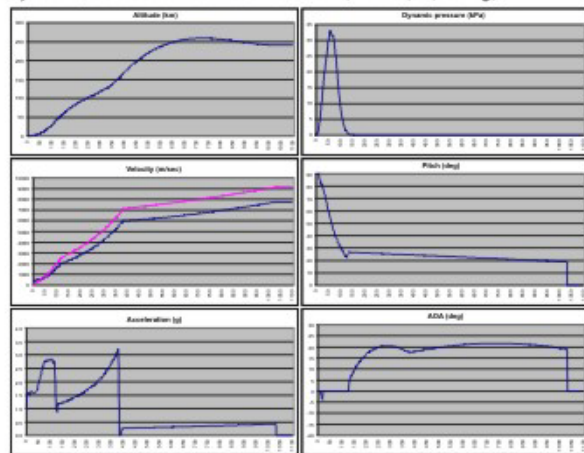
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	412,601lb (187,152kg)
Usable Ascent Propellant	150,522lb (68,276kg)
Ascent Flight Performance Reserve	6,977lb (3,165kg)
Usable Post-Ascent Propellant	-
Post-Ascent Flight Performance Reserve	-
Unusable Residuals	4,006lb (1,817kg)
Ascent In-Flight Losses	239lb (109kg)
RCS Propellant	992lb (450kg)
Propellant Offload	60.19%
Stage pmf	0.9357
Dry Mass	24,068lb (10,917kg)
Burnout Mass	28,074lb (12,734kg)
# Engines / Type	6 / RL-10A-4-2
Engine Thrust (@ 100%) Vac	22,300lbf (10,115kgf / 99,195N)
Engine Isp (@ 100%) Vac	445.2s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	644.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	-
ASE*	3,064lb (1,390kg)

DYNAMICS

Blackzone Safe Trajectory	1.521 : 1
Thrust : Weight @ Liftoff	687.5psf (32,918Pa)
Max Dynamic Pressure	3.21g
Max g's During Ascent	130.0nmi (240.8km)
Insertion Altitude	

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	234,938lb (106,566kg) †
Payload w/ additional 10% Reserve	211,444lb (95,909kg) †



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW

Payload Fairing	5,719,036lb (2,594,111kg)
Payload Envelope	32.8 x 18.4ft (10.0 x 5.6m)
Payload Fairing Jettison Mass	30.2 x 18.4ft (9.2 x 5.6m)
Payload Fairing Jettison	12,571lb (5,702kg)
Launch Abort System Jettison	After Orbital Insertion
Launch Abort System Jettison	16,083lb (7,295kg)
Launch Abort System Jettison	405.0s @ 92.3nmi

BOOSTERS (each)

Design Heritage	Shuttle-derived 5-segment RSRMV
Propellants	PBAN
Usable Propellant	1,380,873lb (626,353kg)
Stage pmf	0.8656
Dry Mass	228,620lb (103,700kg)
Burnout Mass	232,608lb (105,509kg)
# Boosters / Type	2 / 5-segment RSRMV
Booster Thrust (@ 0.7s) SL	3,510,791lbf (1,592,468kgf / 15,616,776N)
Vac	3,510,791lbf (1,592,468kgf / 15,616,776N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	267.4s
Booster Burn Time	126.6s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	8,748lb (3,968kg)
----------	-------------------

Work In Progress

8th June 2009

* ASE is part of the Payload, not additional

† Ascent Performance for Jupiter-246 protects for Upper Stage Single-Engine-Out and full FPR

Vehicle Concept Characteristics - LV 41.5003.10051

UPPER STAGE

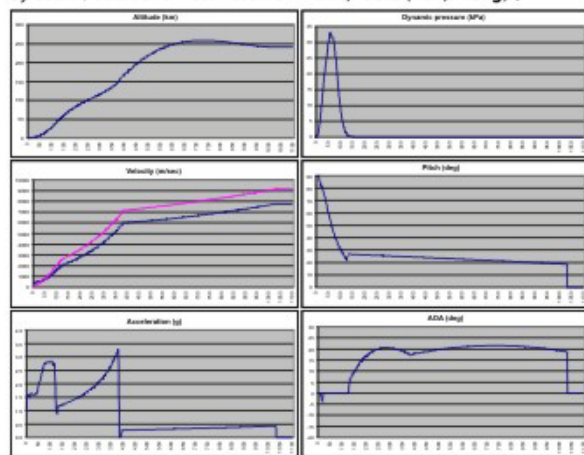
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	412,601lb (187,152kg)
Usable Ascent Propellant	150,522lb (68,276kg)
Ascent Flight Performance Reserve	6,977lb (3,165kg)
Usable Post-Ascent Propellant	-
Post-Ascent Flight Performance Reserve	-
Unusable Residuals	4,006lb (1,817kg)
Ascent In-Flight Losses	239lb (109kg)
RCS Propellant	992lb (450kg)
Propellant Offload	60.19%
Stage pmf	0.9357
Dry Mass	24,068lb (10,917kg)
Burnout Mass	28,074lb (12,734kg)
# Engines / Type	6 / RL-10A-4-2
Engine Thrust (@ 100%) Vac	22,300lbf (10,115kgf / 99,195N)
Engine Isp (@ 100%) Vac	445.2s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	644.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	-
ASE*	1,102lb (500kg)

DYNAMICS

Thrust : Weight @ Liftoff	1.520 : 1
Max Dynamic Pressure	688.2psf (32,949Pa)
Max g's During Ascent	3.28g
Insertion Altitude	130.0nmi (240.8km)

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	249,729lb (113,275kg) †
Payload w/ additional 10% Reserve	224,756lb (101,948kg) †



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW

Payload Fairing	5,721,090lb (2,595,043kg)
Payload Envelope	32.8 x 18.4ft (10.0 x 5.6m)
Payload Fairing Jettison Mass	30.2 x 18.4ft (9.2 x 5.6m)
Payload Fairing Jettison	15,916lb (7,219kg)
Launch Abort System Jettison Mass	351.6s @ 73.5nmi
Launch Abort System Jettison	-

BOOSTERS (each)

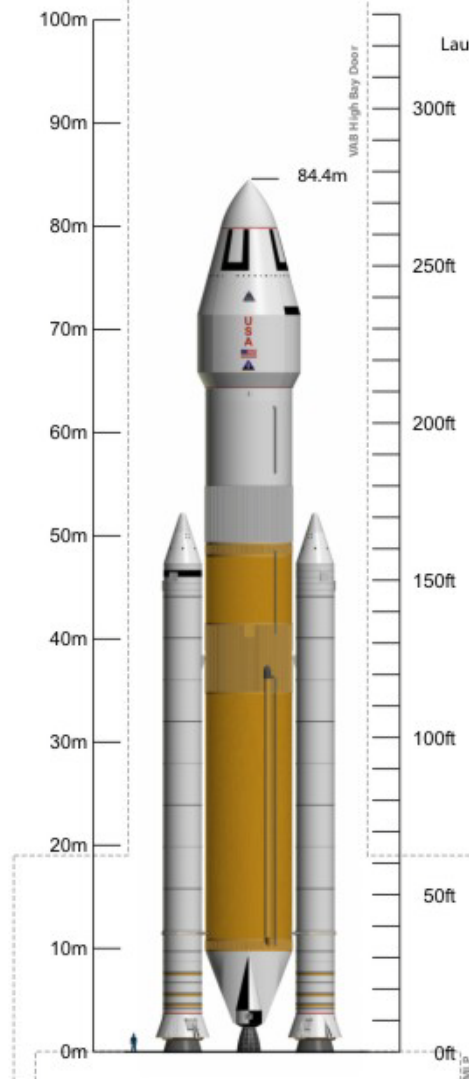
Design Heritage	Shuttle-derived 5-segment RSRMV
Propellants	PBAN
Usable Propellant	1,380,873lb (626,353kg)
Stage pmf	0.8656
Dry Mass	228,620lb (103,700kg)
Burnout Mass	232,608lb (105,509kg)
# Boosters / Type	2 / 5-segment RSRMV
Booster Thrust (@ 0.7s) SL	3,510,791lbf (1,592,468kgf / 15,616,776N)
Vac	3,510,791lbf (1,592,468kgf / 15,616,776N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	267.4s
Booster Burn Time	126.6s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	8,748lb (3,968kg)
----------	-------------------



Work In Progress

8th June 2009

* ASE is part of the Payload, not additional

† Ascent Performance for Jupiter-246 protects for Upper Stage Single-Engine-Out and full FPR



DIRECT - Phase 2

Exploration Operations

Launch Vehicle Option I

Jupiter-246 Heavy
(RL-10B-2)

Vehicle Concept Characteristics - LV 41.5004.08001

UPPER STAGE

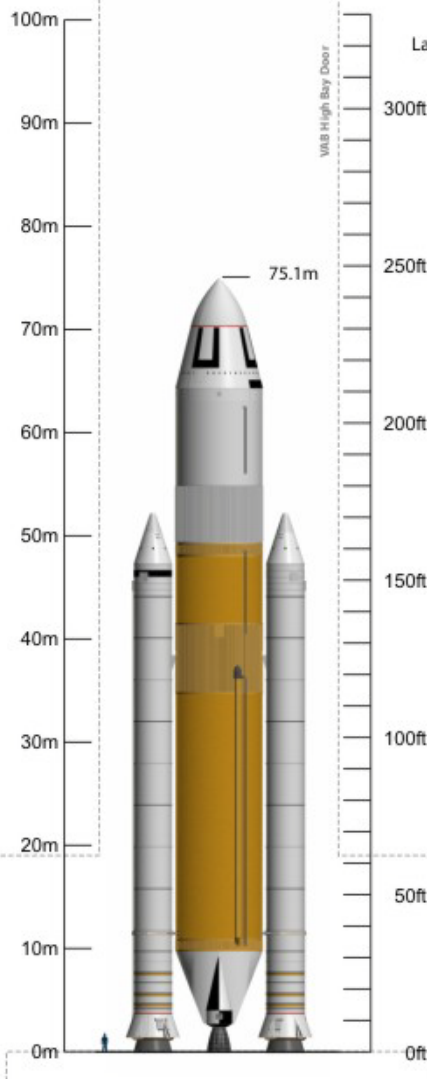
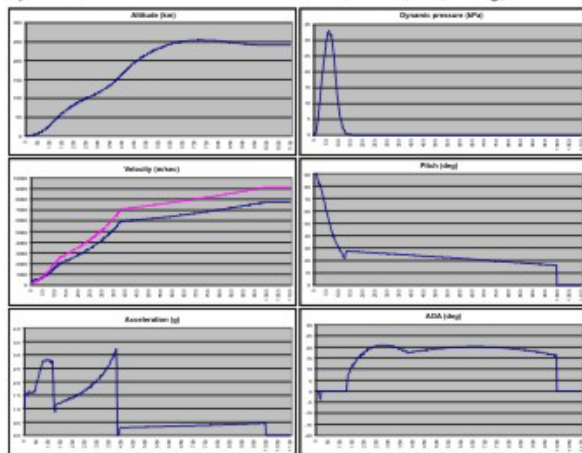
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	420,749lb (190,849kg)
Usable Ascent Propellant	153,349lb (69,558kg)
Ascent Flight Performance Reserve	6,935lb (3,146kg)
Usable Post-Ascent Propellant	253,587lb (115,025kg)
Post-Ascent Flight Performance Reserve	2,561lb (1,162kg)
Unusable Residuals	4,073lb (1,848kg)
Ascent In-Flight Losses	244lb (111kg)
RCS Propellant	992lb (450kg)
Propellant Offload	0.00%
Stage pmf	0.9324
Dry Mass	26,128lb (11,852kg)
Burnout Mass	30,202lb (13,699kg)
# Engines / Type	6 / RL-10B-2
Engine Thrust (@ 100%) Vac	24,750lbf (11,226kgf / 110,093N)
Engine Isp (@ 100%) Vac	459.0s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	609.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	6,935lb (3,146kg)
ASE*	1,102lb (500kg)

DYNAMICS

Thrust : Weight @ Liftoff	1.518 : 1
Max Dynamic Pressure	690.2psf (33,045Pa)
Max g's During Ascent	3.21g
Insertion Altitude	130.0nmi (240.8km)

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	258,243lb (117,137kg) †
Payload w/ additional 10% Reserve	232,418lb (105,423kg) †



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW	5,727,381lb (2,597,896kg)
Payload Fairing	27.6 x 0.0ft (8.4 x 0.0m)
Payload Envelope	25.0 x 0.0ft (7.6 x 0.0m)
Payload Fairing Jettison Mass	8,724lb (3,957kg)
Payload Fairing Jettison	354.1s @ 73.6nmi
Launch Abort System Jettison Mass	-
Launch Abort System Jettison	-

BOOSTERS (each)

Design Heritage	Shuttle-derived 5-segment RSRMV
Propellants	PBAN
Usable Propellant	1,380,873lb (626,353kg)
Stage pmf	0.8656
Dry Mass	228,620lb (103,700kg)
Burnout Mass	232,608lb (105,509kg)
# Boosters / Type	2 / 5-segment RSRMV
Booster Thrust (@ 0.7s) SL	3,510,791lbf (1,592,468kgf / 15,616,776N)
Vac	3,510,791lbf (1,592,468kgf / 15,616,776N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	267.4s
Booster Burn Time	126.6s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	8,748lb (3,968kg)
----------	-------------------

EDS TLI PERFORMANCE

2-Launch EOR	
TLI dV (Adj. for Gravity Losses)	3,215.0m/s (+ FPR)
LEO Loiter Period	5.0 days
TLI Payload Performance*	203,764lb (92,426kg)

Work In Progress

8th June 2009

* ASE is part of the Payload, not additional

† Ascent Performance for Jupiter-246 protects for Upper Stage Single-Engine-Out and full FPR

‡ TLI Performance for Jupiter-246 protects for Upper Stage Dual-Engine-Out and full FPR

Vehicle Concept Characteristics - LV 41.5004.10050

UPPER STAGE

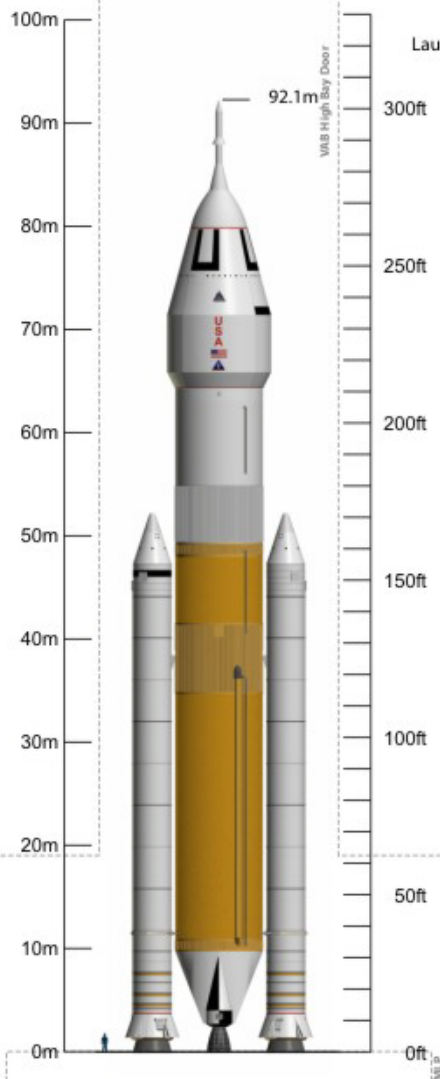
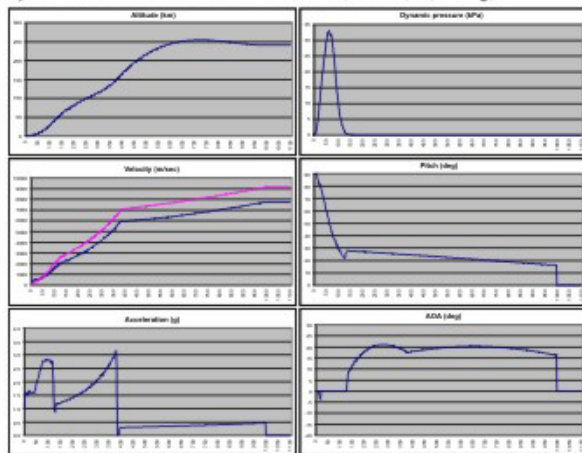
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	420,749lb (190,849kg)
Usable Ascent Propellant	153,349lb (69,558kg)
Ascent Flight Performance Reserve	6,935lb (3,146kg)
Usable Post-Ascent Propellant	-
Post-Ascent Flight Performance Reserve	-
Unusable Residuals	4,073lb (1,848kg)
Ascent In-Flight Losses	244lb (111kg)
RCS Propellant	992lb (450kg)
Propellant Offload	60.27%
Stage pmf	0.9324
Dry Mass	26,128lb (11,852kg)
Burnout Mass	30,202lb (13,699kg)
# Engines / Type	6 / RL-10B-2
Engine Thrust (@ 100%) Vac	24,750lbf (11,226kgf / 110,093N)
Engine Isp (@ 100%) Vac	459.0s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	609.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	-
ASE*	3,064lb (1,390kg)

DYNAMICS

Blackzone Safe Trajectory	1.518 : 1
Thrust : Weight @ Liftoff	690.8psf (33,077Pa)
Max Dynamic Pressure	3.15g
Max g's During Ascent	130.0nmi (240.8km)
Insertion Altitude	

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	240,437lb (109,060kg) †
Payload w/ additional 10% Reserve	216,393lb (98,154kg) †



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW

Payload Fairing	5,729,504lb (2,598,859kg)
Payload Envelope	32.8 x 18.4ft (10.0 x 5.6m)
Payload Fairing Jettison Mass	30.2 x 18.4ft (9.2 x 5.6m)
Payload Fairing Jettison	12,571lb (5,702kg)
Launch Abort System Jettison	After Orbital Insertion
Launch Abort System Jettison	16,083lb (7,295kg)
Launch Abort System Jettison	405.0s @ 90.8nmi

BOOSTERS (each)

Design Heritage	Shuttle-derived 5-segment RSRMV
Propellants	PBAN
Usable Propellant	1,380,873lb (626,353kg)
Stage pmf	0.8656
Dry Mass	228,620lb (103,700kg)
Burnout Mass	232,608lb (105,509kg)
# Boosters / Type	2 / 5-segment RSRMV
Booster Thrust (@ 0.7s) SL	3,510,791lbf (1,592,468kgf / 15,616,776N)
Vac	3,510,791lbf (1,592,468kgf / 15,616,776N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	267.4s
Booster Burn Time	126.6s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	8,748lb (3,968kg)
----------	-------------------

Work In Progress

8th June 2009

* ASE is part of the Payload, not additional

† Ascent Performance for Jupiter-246 protects for Upper Stage Single-Engine-Out and full FPR

Vehicle Concept Characteristics - LV 41.5004.10051

UPPER STAGE

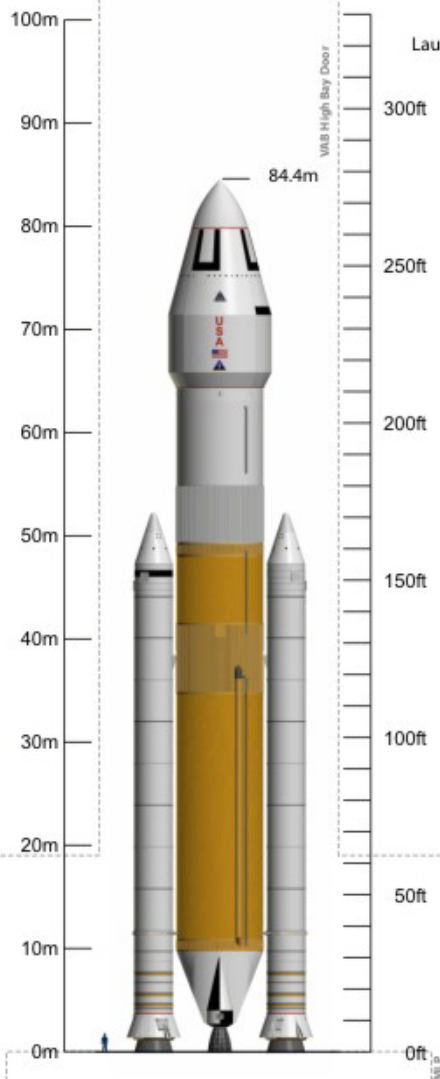
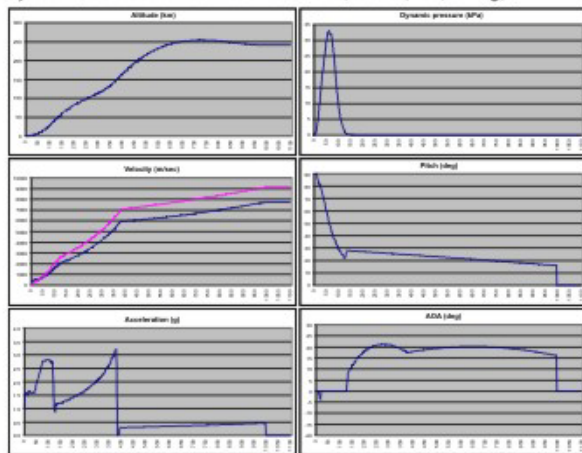
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	420,749lb (190,849kg)
Usable Ascent Propellant	153,349lb (69,558kg)
Ascent Flight Performance Reserve	6,935lb (3,146kg)
Usable Post-Ascent Propellant	-
Post-Ascent Flight Performance Reserve	-
Unusable Residuals	4,073lb (1,848kg)
Ascent In-Flight Losses	244lb (111kg)
RCS Propellant	992lb (450kg)
Propellant Offload	60.27%
Stage pmf	0.9324
Dry Mass	26,128lb (11,852kg)
Burnout Mass	30,202lb (13,699kg)
# Engines / Type	6 / RL-10B-2
Engine Thrust (@ 100%) Vac	24,750lbf (11,226kgf / 110,093N)
Engine Isp (@ 100%) Vac	459.0s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	609.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	-
ASE*	1,102lb (500kg)

DYNAMICS

Thrust : Weight @ Liftoff	1.517 : 1
Max Dynamic Pressure	691.4psf (33,103Pa)
Max g's During Ascent	3.22g
Insertion Altitude	130.0nmi (240.8km)

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	254,888lb (115,615kg) †
Payload w/ additional 10% Reserve	229,399lb (104,054kg) †



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW

Payload Fairing	5,731,219lb (2,599,637kg)
Payload Envelope	32.8 x 18.4ft (10.0 x 5.6m)
Payload Fairing Jettison Mass	30.2 x 18.4ft (9.2 x 5.6m)
Payload Fairing Jettison	15,916lb (7,219kg)
Launch Abort System Jettison Mass	356.3s @ 73.6nmi
Launch Abort System Jettison	-

BOOSTERS (each)

Design Heritage	Shuttle-derived 5-segment RSRMV
Propellants	PBAN
Usable Propellant	1,380,873lb (626,353kg)
Stage pmf	0.8656
Dry Mass	228,620lb (103,700kg)
Burnout Mass	232,608lb (105,509kg)
# Boosters / Type	2 / 5-segment RSRMV
Booster Thrust (@ 0.7s) SL	3,510,791lbf (1,592,468kgf / 15,616,776N)
Vac	3,510,791lbf (1,592,468kgf / 15,616,776N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	267.4s
Booster Burn Time	126.6s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	8,748lb (3,968kg)
----------	-------------------

Work In Progress

8th June 2009

* ASE is part of the Payload, not additional

† Ascent Performance for Jupiter-246 protects for Upper Stage Single-Engine-Out and full FPR



DIRECT - Phase 2

Exploration Operations

Launch Vehicle Option J

Jupiter-247 Heavy
(RL-10A-4-2)

Vehicle Concept Characteristics - LV 41.5003.08001

UPPER STAGE

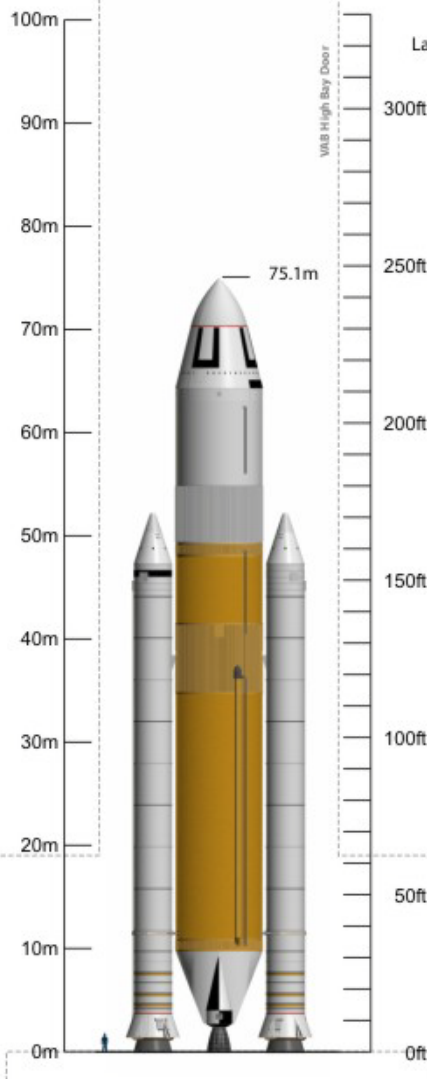
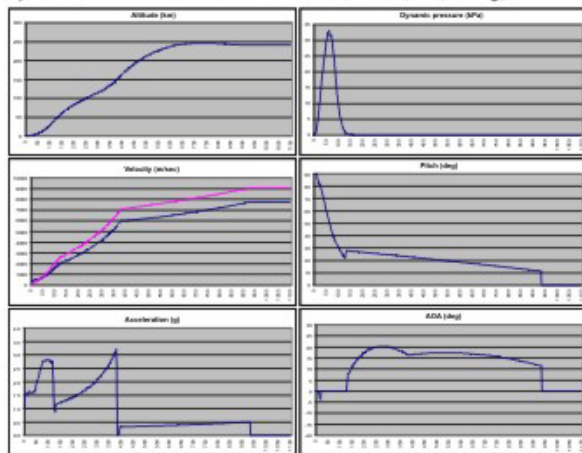
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	420,565lb (190,765kg)
Usable Ascent Propellant	152,690lb (69,259kg)
Ascent Flight Performance Reserve	7,074lb (3,209kg)
Usable Post-Ascent Propellant	253,882lb (115,159kg)
Post-Ascent Flight Performance Reserve	2,564lb (1,163kg)
Unusable Residuals	4,070lb (1,846kg)
Ascent In-Flight Losses	285lb (129kg)
RCS Propellant	992lb (450kg)
Propellant Offload	0.00%
Stage pmf	0.9353
Dry Mass	24,762lb (11,232kg)
Burnout Mass	28,832lb (13,078kg)
# Engines / Type	7 / RL-10A-4-2
Engine Thrust (@ 100%) Vac	22,300lbf (10,115kgf / 99,195N)
Engine Isp (@ 100%) Vac	445.2s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	546.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	7,074lb (3,209kg)
ASE*	1,102lb (500kg)

DYNAMICS

Thrust : Weight @ Liftoff	1.519 : 1
Max Dynamic Pressure	689.7psf (33,021Pa)
Max g's During Ascent	3.21g
Insertion Altitude	130.0nmi (240.8km)

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	258,541lb (117,272kg) †
Payload w/ additional 10% Reserve	232,686lb (105,545kg) †



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW

Payload Fairing	5,725,833lb (2,597,194kg)
Payload Envelope	27.6 x 0.0ft (8.4 x 0.0m)
Payload Fairing Jettison Mass	25.0 x 0.0ft (7.6 x 0.0m)
Payload Fairing Jettison	8,724lb (3,957kg)
Launch Abort System Jettison Mass	354.7s @ 73.6nmi
Launch Abort System Jettison	-

BOOSTERS (each)

Design Heritage	Shuttle-derived 5-segment RSRMV
Propellants	PBAN
Usable Propellant	1,380,873lb (626,353kg)
Stage pmf	0.8656
Dry Mass	228,620lb (103,700kg)
Burnout Mass	232,608lb (105,509kg)
# Boosters / Type	2 / 5-segment RSRMV
Booster Thrust (@ 0.7s) SL	3,510,791lbf (1,592,468kgf / 15,616,776N)
Vac	3,510,791lbf (1,592,468kgf / 15,616,776N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	267.4s
Booster Burn Time	126.6s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	8,748lb (3,968kg)
----------	-------------------

EDS TLI PERFORMANCE

2-Launch EOR	
TLI dV (Adj. for Gravity Losses)	3,205.0m/s (+ FPR)
LEO Loiter Period	5.0 days
TLI Payload Performance*	196,409lb (89,089kg) ‡

Work In Progress

8th June 2009

* ASE is part of the Payload, not additional

† Ascent Performance for Jupiter-247 protects for Upper Stage Single-Engine-Out and full FPR

‡ TLI Performance for Jupiter-247 protects for Upper Stage Dual-Engine-Out and full FPR

Vehicle Concept Characteristics - LV 41.5003.10050

UPPER STAGE

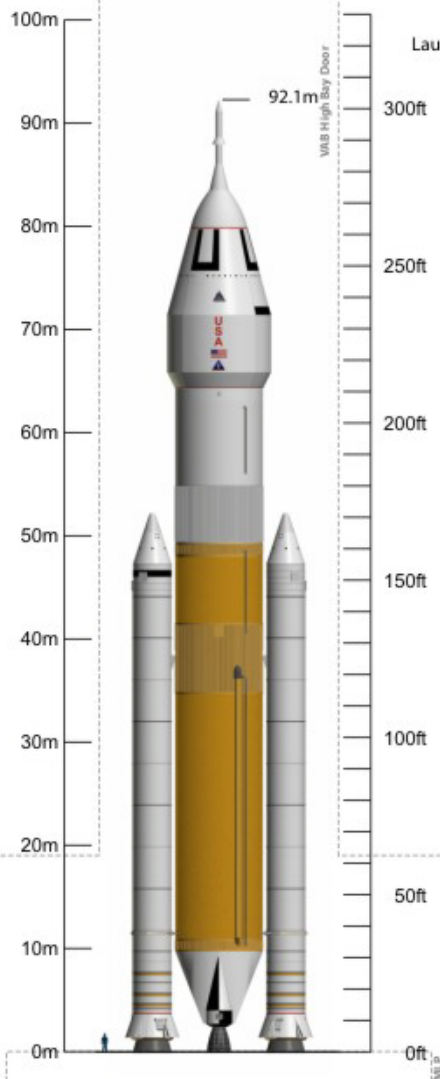
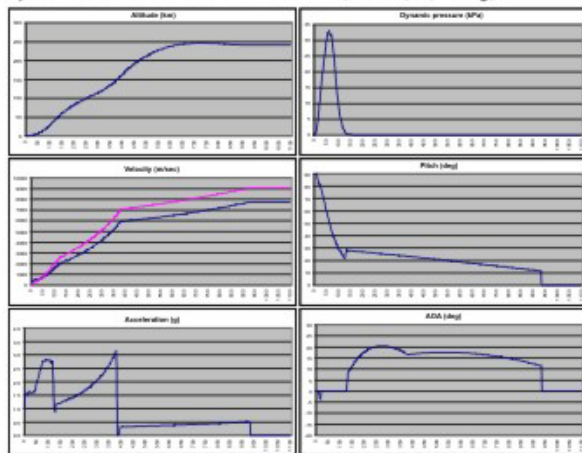
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	420,565lb (190,765kg)
Usable Ascent Propellant	152,690lb (69,259kg)
Ascent Flight Performance Reserve	7,074lb (3,209kg)
Usable Post-Ascent Propellant	-
Post-Ascent Flight Performance Reserve	-
Unusable Residuals	4,070lb (1,846kg)
Ascent In-Flight Losses	285lb (129kg)
RCS Propellant	992lb (450kg)
Propellant Offload	60.37%
Stage pmf	0.9353
Dry Mass	24,762lb (11,232kg)
Burnout Mass	28,832lb (13,078kg)
# Engines / Type	7 / RL-10A-4-2
Engine Thrust (@ 100%) Vac	22,300lbf (10,115kgf / 99,195N)
Engine Isp (@ 100%) Vac	445.2s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	546.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	-
ASE*	3,064lb (1,390kg)

DYNAMICS

Blackzone Safe Trajectory	1.518 : 1
Thrust : Weight @ Liftoff	690.3psf (33,054Pa)
Max Dynamic Pressure	3.16g
Max g's During Ascent	130.0nmi (240.8km)
Insertion Altitude	

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	240,751lb (109,203kg) †
Payload w/ additional 10% Reserve	216,676lb (98,283kg) †



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW

Payload Fairing	5,727,974lb (2,598,165kg)
Payload Envelope	32.8 x 18.4ft (10.0 x 5.6m)
Payload Fairing Jettison Mass	30.2 x 18.4ft (9.2 x 5.6m)
Payload Fairing Jettison	12,571lb (5,702kg)
Launch Abort System Jettison	After Orbital Insertion
Launch Abort System Jettison	16,083lb (7,295kg)
Launch Abort System Jettison	405.0s @ 89.8nmi

BOOSTERS (each)

Design Heritage	Shuttle-derived 5-segment RSRMV
Propellants	PBAN
Usable Propellant	1,380,873lb (626,353kg)
Stage pmf	0.8656
Dry Mass	228,620lb (103,700kg)
Burnout Mass	232,608lb (105,509kg)
# Boosters / Type	2 / 5-segment RSRMV
Booster Thrust (@ 0.7s) SL	3,510,791lbf (1,592,468kgf / 15,616,776N)
Vac	3,510,791lbf (1,592,468kgf / 15,616,776N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	267.4s
Booster Burn Time	126.6s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	8,748lb (3,968kg)
----------	-------------------

Work In Progress

8th June 2009

* ASE is part of the Payload, not additional

† Ascent Performance for Jupiter-247 protects for Upper Stage Single-Engine-Out and full FPR

Vehicle Concept Characteristics - LV 41.5003.10051

UPPER STAGE

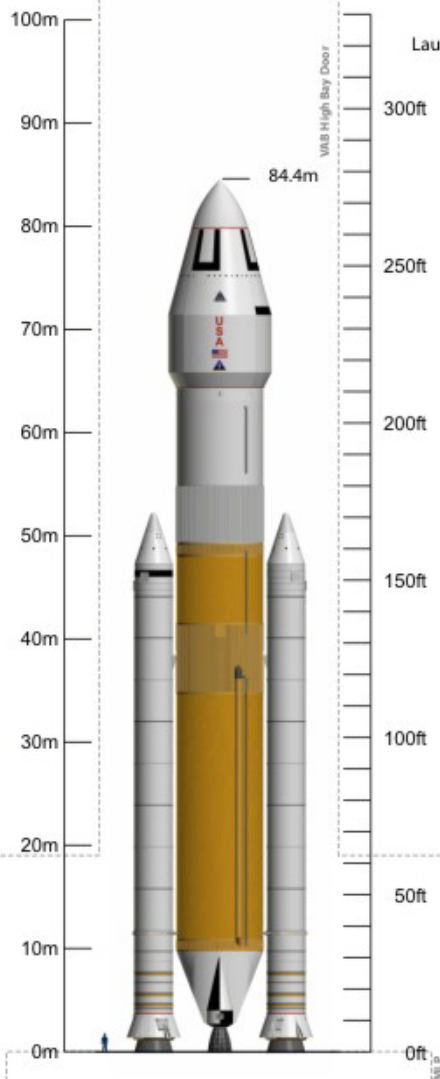
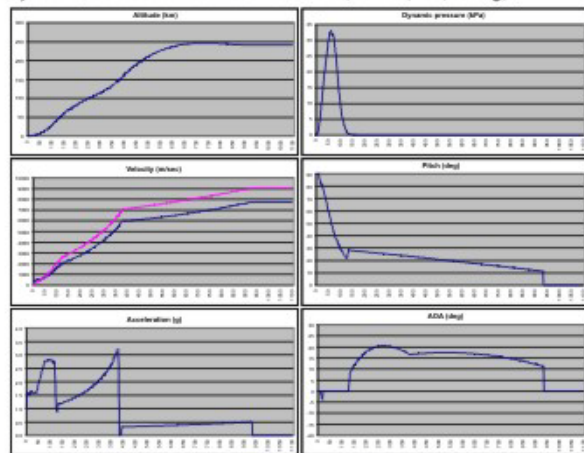
Design Heritage	Boeing ACES / Lockheed-Martin WBC
Propellants	LOX / LH2
Maximum Gross Propellant	420,565lb (190,765kg)
Usable Ascent Propellant	152,690lb (69,259kg)
Ascent Flight Performance Reserve	7,074lb (3,209kg)
Usable Post-Ascent Propellant	-
Post-Ascent Flight Performance Reserve	-
Unusable Residuals	4,070lb (1,846kg)
Ascent In-Flight Losses	285lb (129kg)
RCS Propellant	992lb (450kg)
Propellant Offload	60.37%
Stage pmf	0.9353
Dry Mass	24,762lb (11,232kg)
Burnout Mass	28,832lb (13,078kg)
# Engines / Type	7 / RL-10A-4-2
Engine Thrust (@ 100%) Vac	22,300lbf (10,115kgf / 99,195N)
Engine Isp (@ 100%) Vac	445.2s
Mission Power Level	100.0%
Upper Stage Ascent Burn Time	546.9s
LEO Loiter Period	4 + 1 days
Pre-TLI Overboard Mass	-
ASE*	1,102lb (500kg)

DYNAMICS

Thrust : Weight @ Liftoff	1.518 : 1
Max Dynamic Pressure	690.9psf (33,079Pa)
Max g's During Ascent	3.23g
Insertion Altitude	130.0nmi (240.8km)

ASCENT PERFORMANCE

Delivery Orbit	130.0 x 130.0nmi, 29.0°
Payload w/ regular NASA GR&A's	255,146lb (115,732kg) †
Payload w/ additional 10% Reserve	229,632lb (104,159kg) †



Launch Site

KSC LC-39 (Latitude: 28.6084°)

GLOW

Payload Fairing	5,729,631lb (2,598,917kg)
Payload Envelope	32.8 x 18.4ft (10.0 x 5.6m)
Payload Fairing Jettison Mass	30.2 x 18.4ft (9.2 x 5.6m)
Payload Fairing Jettison	15,916lb (7,219kg)
Launch Abort System Jettison Mass	357.8s @ 73.8nmi
Launch Abort System Jettison	-

BOOSTERS (each)

Design Heritage	Shuttle-derived 5-segment RSRMV
Propellants	PBAN
Usable Propellant	1,380,873lb (626,353kg)
Stage pmf	0.8656
Dry Mass	228,620lb (103,700kg)
Burnout Mass	232,608lb (105,509kg)
# Boosters / Type	2 / 5-segment RSRMV
Booster Thrust (@ 0.7s) SL	3,510,791lbf (1,592,468kgf / 15,616,776N)
Vac	3,510,791lbf (1,592,468kgf / 15,616,776N)
Booster Isp (@ 0.7s) SL	237.0s
Vac	267.4s
Booster Burn Time	126.6s

CORE STAGE

Design Heritage	Shuttle Super Light Weight Tank ET
Propellants	LOX / LH2
Gross Propellant	1,621,191lb (735,360kg)
Usable Ascent Propellant	1,604,979lb (728,006kg)
Unusable Residuals	16,047lb (7,279kg)
In-Flight Losses	325lb (147kg)
Propellant Offload	0.00%
Stage pmf	0.9075
Dry Mass	147,479lb (66,895kg)
Burnout Mass	163,526lb (74,174kg)
# Engines / Type	4 / SSME-Block-II
Engine Thrust (@ 104.5%) SL	392,326lbf (177,956kgf / 1,745,155N)
Vac	490,847lbf (222,644kgf / 2,183,396N)
Engine Isp (@ 104.5%) SL	361.4s
Vac	452.2s
Mission Power Level	104.5%
Core Burn Time	384.1s

INTERSTAGE

Dry Mass	8,748lb (3,968kg)
----------	-------------------

Work In Progress

8th June 2009

* ASE is part of the Payload, not additional

† Ascent Performance for Jupiter-247 protects for Upper Stage Single-Engine-Out and full FPR